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DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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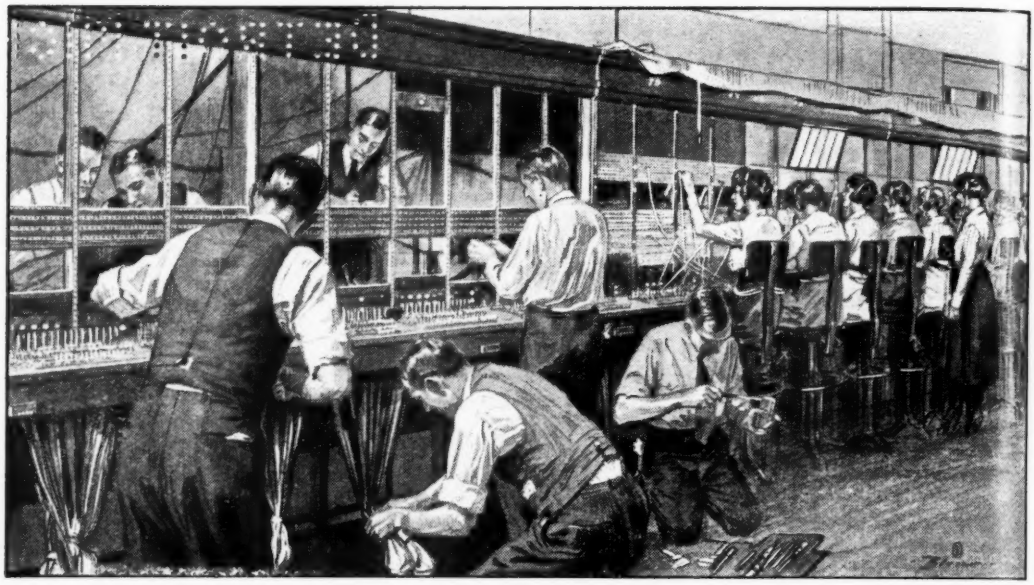

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EDITORIAL

FINANCING ROAD AND STREET PROJECTS

So important has the financing of roads and streets become that in the case of roads, at least, it is now receiving more study than any other factor in the problem. Design and construction are, for the present, overshadowed by finance.

When the American people finally made up their minds to build roads on a great scale they were not especially critical of the financial arrangements. Now this is changed. The people now feel the weight of the cost of modern roads and an individual is quick to oppose a project if he feels that he will be asked to bear more than his fair share of the burden. But he is willing to bear his share, so the problem is to work out equitable taxation for road and street purposes.

The old principle of assessment according to benefits is the one toward which road taxation is rapidly turning. A good road is of some service, directly or indirectly, to every person residing in the political subdivision in which it is located, so it is entirely fair to levy general taxes to pay in part for the cost of road construction. It is evident to all that the man who uses the road derives more benefit from it than the one who does not, and the vehicle license fee, which should be turned into the road fund, is the approved method of paying for this benefit. It is also evident that the vehicle license fee, while all right as far as it goes, does not go far enough in fairly exacting payment for benefits, for the man who drives a car 15,000 miles a year should pay more for the privilege of using the roads than the man who drives only 5,000 miles. The gasoline tax, now rapidly growing in favor throughout the entire country, is an attempt to charge road users in direct proportion to their use of the roads. It is also evident that the man living close to a road derives more benefit from it than the man who does not, and tax officers are giving thought to the formulation of equitable plans for taxing property holders in the areas adjacent to a new road. The man whose farm lies along a new hard-surfaced road finds that the construction of the road adds to the market value of his property. Surely he should pay something for this direct benefit in addition to his general road tax.

Perhaps the most significant development in financing street improvement projects is in the attempt again to tax according to benefits as shown in the increasing practice of paying for resurfacing and reconstruction out of general tax funds instead of assessing such costs against the abutting property. It is argued, and quite soundly so, that although the first paving of a street increases property values, resurfacing or repaving does not, so while it is equitable to assess the first cost against the abutting property, it is not fair to make the abutting property pay the subsequent costs arising from the destruction of the pavement by traffic originating at distant points.

The best thought of road and street engineers should now be turned to this problem of equitable financing.

THE GRAVEL ROAD

It is generally agreed that gravel roads do very well for secondary road construction, serving as feeders to hard-surfaced primary roads, but attempts to make the gravel road a primary road are to be deprecated. The primary road should be of such construction that it will carry rapidly and safely all forms of legitimate, modern traffic at any time of the day or night, in any season of the year, and in any kind of weather. A gravel road does not meet these requirements.

All this is equivalent to saying that a

gravel road is all right in its place, but attempts to make it serve as a substitute for higher types prove both disappointing and expensive. There is a general disposition to speak well of the gravel road because of its long service to the American public and because of its good qualities within its natural limitations, and very little would be said against it but for the fact that one occasionally hears comparisons drawn between gravel and higher types in favor of the gravel road. Such comparisons are usually made by motorists who use the roads but infrequently, and then only in dry weather, who fancy that gravel possesses superior riding qualities. It is noteworthy, however, that where the motorist has his choice between two roads, one of gravel and the other of a higher type, when he is actually on the road, he almost invariably chooses the hard-surfaced road even if it is the longer of the two. A good example of this fact is found in the trip between Indianapolis and Chicago. One route, the shorter by 30 miles, is almost entirely of good gravel construction under excellent maintenance, while the other is for something over half its length of hard-surfaced types. Fully 90 percent of the traffic between these two cities is over the longer route. Thus it is seen that in driving 225 miles motorists are willing to go 30 miles out of their way in order to secure the advantages in comfort and safety of driving on 130 miles of modern roads.

It is interesting to observe the effects of travel on this trip. Going one way, the driver and his companions are tired at the end of 95 miles, the end of the gravel road. After driving another 130 miles over hard roads all are pretty well rested again. On the return trip there is only moderate fatigue at the end of the 130 miles of hard roads, while after driving another 95 miles over gravel, children, especially, are thoroughly tired. Any one who takes this trip, or a similar one, will appreciate the fact that gravel is not suitable for primary road construction for passenger traffic from the standpoint of creature comfort, even if the dust is disregarded. There is a bodily weariness produced by the gravel road to which the traveler over a higher type is a stranger.

In the early spring and late fall, when the trip is attempted, all the anxiety as to the condition of the road centers in the gravel section. Not a thought need be given the hard-surfaced section, for it is always good. The gravel section may be rough and rutted, out of surface, bottomless and otherwise in poor shape, due to nothing else but the inability of gravel to cope successfully with the elements and modern traffic in bad weather. Even in good weather one cannot be sure that a smooth gravel road on one day will be smooth the next, for loose gravel may be placed on it by the maintenance crew at any time, rendering it difficult and dangerous to use.

The gravel road suffers even more in comparison with hard roads for commercial vehicle traffic and from the standpoints of gasoline consumption and wear and tear on vehicles and tires. Sentiment and false economy aside, the gravel road simply is not suitable for use on primary roads.

HIGHWAY BRIDGE ENGINEERING

The highway bridge engineer has been somewhat neglected by the engineering press. While it cannot be said that there is any lack of appreciation of the importance of highway bridges, it is undoubtedly true that the great sums spent for highway paving have caused many to overlook the comparatively modest expenditures for bridges and, incidentally, to overlook the work of the bridge engineers. Then, too, the great paving operations have led to many innovations in construction methods and equipment of great news value and immediate economic importance. There have been few innovations in bridge building during recent years and so, what with one thing and another, the highway bridge engineer has not been granted the recognition to which he is entitled.

Attention is called to this fact as a preliminary to greater recognition of the bridge builder in this magazine. A number of articles are promised on interesting highway bridge construction jobs for early publication.

SIDE LIGHTS ON MUNICIPAL PAVING PRACTICE—RECENT WORK SHOWS MANY IMPROVEMENTS

By Harlan H. Edwards, C. E., City Engineer, Danville, Ill.

A survey of improvements made in a number of our representative cities within the past year shows that municipal engineers are consistently giving greater thought to the creation of smooth durable pavements at lower costs. They are also devoting more time to the study and introduction of details which make for increased strength in the placing of many of our city thoroughfares on a par with the state highways, as regards their riding qualities and permanence.

Confronted with the existence of many old wornout pavements which required resurfacing, and with the need for scores of new and substantial arteries of travel our engineers have met the public demand in various ways. Renewal of life by re-surfacing has been the favorite remedy for our old streets, the methods employed varying in different cities. Some replaced the old wearing surface with asphalt filled brick, others used one of the various forms of the bituminous pavement, while still others cast their lot with concrete, all, however, with the one idea of conserving what they already had, and adding what was necessary to obtain the desired strength. New pavements have consistently been made stronger to withstand the increasingly heavy traffic and have changed but little in design from the accepted standards.

Bituminous Mastic Cushion a Success

One of the most recent improvements in brick pavement design has been the investigation and approval of the use of the bituminous mastic cushion in place of the old troublesome sand cushion. Sand mixed with about 10% Tarvia B, a cold application tar product, forms a resilient, non-flowing, easily laid bed for the asphalt filled brick top, and makes possible a permanently smooth surface free from the little dips or low brick caused by the working of the old sand cushion through cracks in the concrete base. The section of the Bates Test Road built in this manner and having only a 5½ in. concrete base was the only brick paved section to come through the tests on the Bates road unscathed, and gave an undisputed recommendation to this type of construction.

Wide Joints Not Essential for Good Asphalt-Filled Lugless Brick Pavements

Considerable complaint has been voiced by various engineers and inspectors on brick pavement construction where lugless brick and asphalt filler is used, on account of the apparent difficulty encountered in filling every joint between every brick its entire depth with asphalt. They bewail the fact that the lug brick has been abandoned because the brick sometimes lie so close that the filler cannot penetrate between them. Careful consideration of the facts in the case, however, will reveal that the admonition "fill every joint from top to bottom" when cement grout filler is used, has been so well learned that the consideration of the real functions of the bituminous filler has been lost sight of.

Flexibility, cleanliness, and the elimination of expansion stresses are the greatest points in favor of the asphalt filler. The first and the last points were fulfilled by the sand filler, with which many of our oldest and best brick streets were constructed, and in which, incidentally, lugless brick were used. Protection of the edges of the brick at the joints, however, was not afforded by sand, and the item of cleanliness was not seriously thought of. Bituminous fillers, however, fulfill all the conditions demanded, and in addition have the advantage of reduction of wear at the joints, quietness, and cleanliness, which in these days of greater sanitation is an important item.

From the standpoint of permanent smoothness and continuity of suface as well as cleanliness, narrow joints are very desirable, for where brick are in such contact that even liquid asphhalt at high temperatures will not penetrate the joints, it is folly to worry about it. Since close contact reduces the cobbling or wear of the brick at the joints, it makes for smoother, longer lived surface and a lower annual maintenance cost to have the narrowest joints possible.

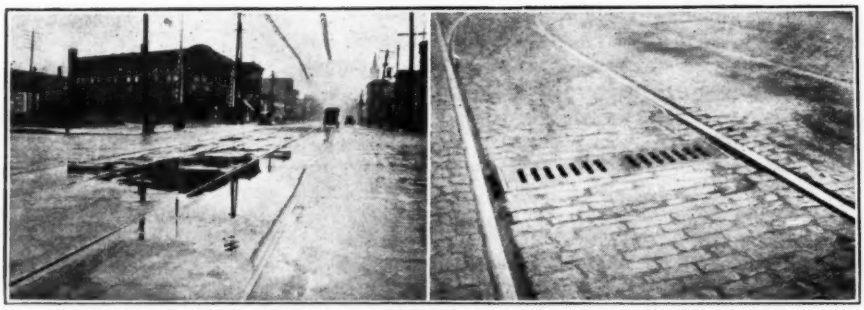
The supposition that bituminous filler produces a waterproof pavement is not true. An examination of many pavements at different intervals shows that the sand cushion or bedding course under the brick is always wet after a rain. It shows also that contraction of the surface in cold weather produced cracks between bricks and the filler which are sometimes large enough to admit a knife blade. Manifestly, then, the idea of waterproofness is erroneous and the need for filling every

joint, however small, with bituminous filler, does not exist.

It seems that many of us are prone to make a big fuss over little unessential things, while at the same time we disregard the bigger things which are really the controlling factors in determining whether or not the pavement as laid will give its proper service. Contrary to the characteristics of the cement grout filler, bituminous filler will not permit stresses which will "pop off" the tops of the brick or cause blow ups in hot weather if it penetrates but a fraction of the entire depth of the brick. It is not so essential that the sand or bituminous mastic cushion be such that it will not work up part way between the brick under the roller, and thus prevent full penetration of the filler the entire depth of the brick. Full penetration is desirable, but not so much so that it would warrant an increased cost or a sacrifice of wearing qualities of the pavement to insure it.

Building Adequate Crowns on Old Streets

Many of our old streets needing resurfacing have become so worn and flattened out by years of travel that new crowns must be built up, in order that proper drainage may be obtained, and that the appearance of the pavement may be enhanced thereby. In some sections of the street this means the use of from 4 to 6 ins. of material, but it is well worth the expense. In most cities the minimum thickness of the new surface is used at the gutters, marking the elevation of the gutter line every 20 ft. by chisel on the face of the curb. From this line the proper crown is teed in along the street, setting plugs, pins or bricks at the correct elevations along the center and the quarters to insure the obtainance of the required slopes. When such methods are used the resurfaced street has the appearance of an entire new job and is the pride of the property owners and citizens in general. Little objection is ever raised by these people to the expenditure of money, provided they can see that they are getting their money's worth.



DRAINAGE OF STREET CAR TRACK PAVEMENT AT DANVILLE, ILL.
Left: Standing Water on Wood Block Pavement in Car Track. Every Passing Car Splashes Water on All Sides. Right: Track Drain in Place. Note Clean and Smooth Condition of Pavement.

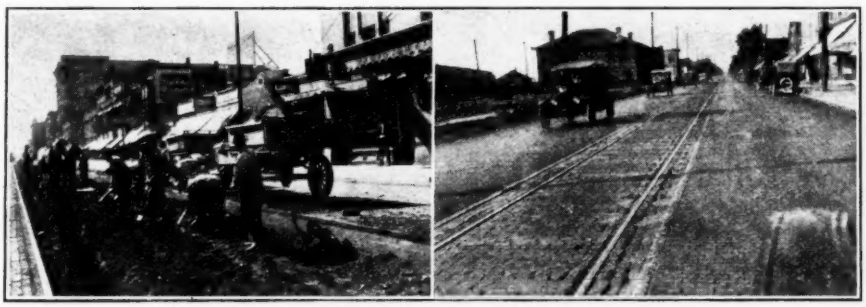
Use of Salts in Concrete Increasing

The use of calcium chloride and kindred chemicals for accelerating the hardening and curing of concrete pavements and bases is increasing as the engineer appreciates the cost to the public of keeping their thoroughfares closed for indefinite periods of time. Dissolved in the mixing water or put in the drum of the mixer before materials are added, the flake calcium chloride becomes thoroughly incorporated in the concrete and greatly shortens the hardening period, enabling traffic to use the pavement in nearly half the usual time. Although a success in some places, the use of flake calcium chloride cast over the surface of the pavement for curing purposes has not become thoroughly established as standard practice, owing to the apparent bad effect of some impurity in the commercial product. Where absolute uniformity of covering is secured, this trouble does not usually manifest itself, but where lumps or small piles of the chemical are allowed to stand on the concrete, "rotten" spots often result. Further investigation may eliminate the cause of this trouble, so that the good qualities of this practice may be made available for all, and eliminate the expense of covering with wet earth, ponding, etc., and incidentally shorten the long period of curing so that the roads may be available to public travel. Of course, the use of this chemical in cold weather concreting has already become standard practice, so that

road building operations, and especially those using central mixing plants, may be run well into the winter without fear of damage. The recommended amounts to be used are not as yet entirely agreed upon, but one authority recommends about 4% calcium chloride, while another claims that 2% calcium chloride mixed with 9% ordinary salt, the percentages being of the weight of the mixing water, gives the best results. It is hoped that experiments now being carried on will decide this question.

Important Details in Track Construction

Many cities are afflicted with poorly-laid street car tracks which are noisy, uncomfortable to ride over, and impossible to keep in proper repair. They are not only a source of damage to the traction company's rolling stock, but are also a source of great damage to the pavements in which they lie. Built with the idea of "saving money," their history has shown a large and unwarranted cost of upkeep—greatly off-setting the "saving" effected at the time of construction.



HEADER CURB CONSTRUCTION AT DANVILLE, ILL.

Left: Car Track Being Replaced, Note Header Curb—Concrete Header Curb. Note Difference in Condition of Car Track and Street Pavements.

Seemingly small details of construction oftentimes govern to a large extent the life of the track structure and also the life of the pavement above and adjoining it. Thorough drainage of the track structure is an essential part of such work. Surface water running along the flangeway next to the rail gradually finds its way into the track foundation, softening and reducing its bearing power. Settlement and damage is the inevitable result of such action if the water is not removed from the track and flangeway quickly. Standing water along the car track not only damages the track itself and the pavement adjacent, but it also has a potential damage to pedestrians who happen to come in contact with muddy water splashed by cars running through these pools. The use of track drains to remove this water which is the cause of all of these troubles is very effective.

A drain which has proved inexpensive and simple of installation is shown in the illustration. Fitting as it does between ties and extending from rail to rail, it is necessary only to lay a line of vitrified tile from the drain to a sewer and pour concrete inside the drain for its floor, sloped to carry the water to the tile. The pavement is laid even with the surface of the drain casting, thereby causing no hump or uneveness whatever in the street.

Poorly laid track means quickly and permanently damaged pavements above it. Injury and destruction, however, is not confined to pavement in the track space alone, but is spread out into the street on each side by the continuous vibration and movement of the rails and ties under traffic. Structures not owned or paid for by the car company are damaged by this action also, and until the past few years no action has been taken to confine the damage to the point of its origin. Substantial track construction eliminates all of these troubles and cuts out the source of many complaints against the street railway companies.

In cities where the car tracks are not well laid or have become in bad condition due to lack of maintenance, the damage caused by such poor construction is confined by means of a header curb on each side of the railway's right-of-way. This curb is in reality a little wall, protecting the city's pavement from damage by the movement of the tracks. It really separates the paving into three sections—the portion in and along the tracks and that on each side, thus confining the damage to the point of origin. It also acts as a retainer of the pavement foun-

dation, permitting the entire removal and replacement of the track structure without damaging the adjacent pavement.

The header curb is composed either of concrete, of a combination of concrete with steel angle paving guard, of creosoted wood block, or granite, and is usually 6 ins. thick and from 18 to 24 ins. deep, thus bringing the base of the curb well below the bottom of the track structure. It is usually concealed from view, yet it is there and functions continually.

The foregoing items are but a few of the many improvements which have been made, and are well representative of the more important items. It is well said that no structure is stronger than its weakest part, and pavement construction is no exception. It is true that many of the items mentioned constitute but a small part of the total cost of the work, yet the lack of such small items may eventually cause the destruction of the whole. It is impossible, of course, to prescribe standard details which would fit every case. Every job tackled is different from the preceding one in some respect, so that every detail of construction like every pavement has its own place. There is no one best practice, but rather the selection of the most suitable types of construction for the individual job constitutes the engineer's work and it is in his judgment in making this selection that his worth to the municipality is revealed.

DATA ON BRICK PAVEMENT CONSTRUCTION AT DETROIT, MINN.

By John F. Druar, of Druar & Milinowski, Consulting Engineers, Globe Bldg., St. Paul, Minn.

A very successful brick pavement has just been completed by the city of Detroit, Minnesota. Druar & Milinowski, Municipal Engineers, St. Paul, Minnesota, were the engineers in charge of this work and S. Birch & Sons Construction Company of Fargo, North Dakota, were the contractors.

The materials used on the work were of the best grade throughout, and every precaution was taken by the engineers to see that the specifications were rigidly followed. Mr. W. A. Vaughn was resident engineer on the work and had two capable assistants, William E. Frank and R. J. Kewley, all of whom performed their specific duties in a splendid manner. Mr. Milinowski or Mr. Druar visited the work at about 10-day intervals throughout the construction. Great care was given the supervision inasmuch as a considerable amount of the pavement went on some newly filled water and sewer trenches. The concrete base of the pavement was reinforced over these trenches as was the curb.

There was a large amount of incidental work connected with the pavements, such as the re-location of catch basins on storm sewers, the moving of ornamental light posts, installation of electric conduits, steam lines and the mushroom center lights, some of which was due to the widening of the streets. The greatest width of a street, curb to curb, was 76 ft., while none of the streets are less than 36 ft. curb to curb.

The pavement was laid to conform to all requirements of the State Highway Commission as the city of Detroit will have a refund on that amount of pavement over which the state highway traffic passes.

The engineers made a report on this work, together with estimates of the cost of the various types of pavement in October, 1921, and the estimated cost of the various types of pavement for 27,705 sq. yds. of pavement, the necessary grading and curb and incidentals was as follows:

For 7½-in. one course concrete pavement, 1-2-4 concrete....$101,795.40
For 2½-in. asphaltic pavement on 6-in. concrete base..... 129,500.40
For 3-in. brick paving on 6-in. 6-in. concrete base 129,500.40
For 3½-in. woodblock paving on 6-in. concrete base 184,910.40

The bids were called for and opened on Feb. 14, 1922. The brick paving was selected for a total of 29,578.5 sq. yds. of pavement, the bid price on brick being $138,535.

The contractor started his work on April 16, 1922, and completed it at a total cost of $138,800 on Sept. 15, 1922, although he was handicapped for a month or so due to delays beyond his control, such as coal and railroad troubles.

The remarkable part of this work was the unusual price obtained by the City for brick paving, and although there was a considerable amount of extra reinforcing steel and changes to the grade and position of ornamental posts, sewer manholes and catchbasins, the total cost was only $265 over the bidding sheet figures on the letting of the contract.

In addition to the pavements put in by the City, the engineers supervised the laying of a considerable area or pavement

on the Northern Pacific R. R. Co.'s property and depot approach, which was completed under the same specifications.

The comparative bidding costs on nine different pavements represented were as follows:

TABULATION OF LOWEST BIDS RECEIVED FOR PAVEMENTS AT DETROIT, MINNESOTA, FEBRUARY, 1922

Kind	Base	Top	All Else	Total
3 -in. Penetration Macadam (Tar)	$1.56	$1.35	$.71	$3.62
2 -in. Topeka Type (Native Lake)	1.76	1.58	.41	3.75
2 -in. Bitulithic (Native Lake)	1.60	2.45	.65	4.70
2½-in. Sheet Asphalt (Native Lake)	1.76	1.86	.40	4.02
3 -in. Brick (Pitch Filler)	1.15	2.83	.64	4.62
3 -in. Wood Block (Pitch Filler)	1.76	2.90	.40	5.06
3½-in. Wood Block (Pitch Filler	1.76	3.20	.40	5.36
7½-in. One course Gravel Concrete	2.20	...	.44	2.73
7½-in. One course Stone Concrete	2.57	...	.61	3.18

All Bases 6-in. Gravel Concrete. Above figures are per sq. yd.
Curb (gravel) .48 to .88 per linear foot.
Combined curb and gutter (gravel) .74 to 1.42 per linear foot.

From this, you will see the extreme low cost of the work to the City, which will be analyzed still further in the successful contractor's bid prices which follow:

Excavation per cubic yard, $.85. This included either filling the excavated material back of the curb to the boulevard or a haul of not to exceed 2,000 ft. to the dump. For any greater length of haul, an overhaul charge of 3 cts. per cu. yd. per 100 ft. was allowed.

1-2½-5 concrete in place at $9 per cu. yd.

Metal reinforcement $.05 per pound in place.

Miscellaneous iron and steel $.07 per pound in place.

8-in. vitrified sewer pipe drains in place $.65 per foot.

Changing elevation of sewer and heating manholes $3 each.

Changing line and elevation of ornamental lights $11 each.

Traffic mushroom signals in place at street intersections $45 each.

3-in. fibre duct in place $.25 per foot.

Plain concrete curb 6-in.x18-in., $.48 per foot.

Concrete 6-in. base of pavement in place, 1-2½-5 concrete, washed gravel, aggregate $6.90 per cu. yd.

3-in. brick pavement with 1-in. sand cushion and pitch filler sanded surface, $2.83 per sq. yd.

4-in. concrete sidewalks repaired, $.25 per sq. ft.

From the above, the reader will see that the contractor did not have much margin on the work, especially when you take into consideration the following facts:

Brick

All brick originally was contracted for from the Purington Brick Company, Galesburg, Illinois, but owing to coal strikes and the car situation, it was necessary to have the balance of the shipments come from the Alton Brick Co., so that about two-thirds came from the former company and one-third from the latter.

Owing to the State Trunk Highway reimbursement, it was necessary to have records of all tests on brick, sand, gravel, bituminous filler, cement, etc. Therefore, the engineers arranged for making the tests by the State Highway Department at the University of Minnesota under Mr. F. C. Lang, Engineer of Tests, and as a matter of courtesy to Mr. Lang, the Illinois Highway Department sent an inspector to the brick yards to test the brick and see them loaded. The cement tests were made at the Q. A. Hall Laboratories of St. Paul, Minnesota. The reports of tests on all material entering into the work were sent to the engineers, Druar & Milinowski for careful checking. Tests were also made on concrete cylinders cast from time to time from the actual street materials. Sand and gravel was obtained from a local pit about one mile from the work.

The contractor opened this pit and equipped it with a modern washer of the reciprocating type. This washer was also equipped with two bins, one for sand and the other for gravel. The oversized gravel, of which there was no great quantity, was discharged over the side of the pan and removed from time to time in wagons. The wash water was discharged down a long flume onto low lying ground leased for the purpose by the contractor. The gravel was not very dirty but did not average over 25% to 30% gravel and there was a large amount of material handled for the amount of washed gravel obtained. The wash water was piped from the end of the city mains, a distance of 1,600 ft. through 4-in. wrought iron pipe and about 200 gals. per minute were used while the washer was running. One of the engineers was stationed at the pit, and saw to it that proper proportions of sand and gravel went in each load. This

gravel and sand was used in the base and in the curb, and the sand was used for the sand cushion. Tests were made daily and a random test sheet shows as follows:

Retained on 2¾-in. screen	0
Passing 2¾-in. screen	100
Passing 2 -in. screen	89.8
Passing 1½-in. screen	74.1
Passing 1 -in. screen	47.7
Passing ¾-in. screen	33.1
Passing ¼-in. screen	2.3
Passing ⅛-in. screen	2.0
Percent loss by abrasion test	5.4
Percent shale	0
Percent slate	0

Sample test of the sand was as follows:

Percent passing 2 -in. screen	100
Percent passing ¼-in. screen	93.5
Percent retained on ¼-in. screen	6.5

The part passing the ¼-in. screen showed:

45.7% passing No. 20 sieve
7.5% passing No. 50 sieve
2.2% passing No. 100 sieve

The color plate test was No. 1. The loss by elutriation was 1.38. The tensile strength of 1 to 3 mortar showed an average of 373 in seven-day test and 457 in the 28-day test as compared with 297 and 400, respectively, for Ottawa sand mixed in the same proportion and with the same cement.

The accepted bid was $1.15 per sq. yd. of 6-in. concrete base; $2.83 per sq. yd. of 3-in. brick top, including the sand cushion and pitch filler, all complete in place. The cost of all curbs, manholes, traffic lights, electric fibre ducts and similar miscellaneous construction items amounted to $.64 per sq. yd. of paved surface or a total of $4.62 per sq. yd.

The price of the curb was $.48 per linear foot.

The pitch filler was an oil asphalt furnished by the Standard Oil Company. Samples of this were taken both from the cars and from the kettles on the street. The total amount of asphalt filler used was 355,000 lbs., or about 12.1 lbs. per sq. yd. of brick surfacing.

An engineer was stationed at the mixer to see that the proper proportions of cement and water were used in the concrete and the resident engineer saw the concrete placed and brought to the finished grade of the base. The base was allowed to stand and was kept wet for two weeks before the 1-in. sand cushion and brick was placed.

On the completion of the work, the pavement was well sanded and the resulting surface even during a heavy rain did not show a puddle. In other words, the surface of the pavement was practically perfect, and the Council and citizens are well pleased with the work.

While the total cost of the pavement was $138,800, the assessment was spread at $150,216. This allowed for the engineering and other incidental expense and a fair amount left over in the paving fund. As the City at large put in the storm sewers, the whole cost of the pavement was assessed against the abutting property, including the intersections, and in accordance with the law, this amount may be paid in cash or over a period of 20 years. The following charge was made per foot front for the various widths of pavement:

36-ft. pavement	$13.14 per front foot
42-ft. pavement	15.33 per front foot
44-ft. pavement	16.06 per front foot
46-ft. pavement	16.79 per front foot
48-ft. pavement	17.52 per front foot
56-ft. pavement	20.44 per front foot
76-ft. pavement	27.74 per front foot

About 10 per cent of the cost of the pavement was paid by the N. P. R. R. Co. and the same amount was paid by the County for paving in front of the Court House and the City paid for their frontage.

In all, about 75,000 brick were culled in the street during the laying. Brick was rejected if an average of 23% by weight or an individual loss of 25% by weight was found. Thirty bricks were supplied by the contractor from each carload and of these the laboratory selected 10 for the test. The average tests shown throughout totaled about 20.6% for rattler loss by weight. The bricks averaged 8½-in. long x 3⅞-in. wide and 3-in. deep and were lugless.

In conclusion, we wish to say that brick paving in Minnesota has not been pushed as hard by the Brick Association as might be, owing to the high freight cost of shipping in the brick. There is no satisfactory paving brick made at present in Minnesota.

It is estimated that this pavement will still be in good condition after 40 years of service and under these conditions, if low prices such as given here could be had, there is no reason why brick pavement should not be used extensively in the next few years in this section of the country.

RELATION BETWEEN BITUMEN AND FINE MINERAL ASPHALTIC MIXTURES

By Hugh W. Skidmore, Consulting Engineer, Chicago Paving Laboratory, Inc., 160 N. Wells St., Chicago, Ill.

While the design of asphaltic mixtures assumes the use of materials complying with certain requirements, such as grading of the sand, hardness and shape of

the sand particles, fineness and absorptive ability of the filler, together with the well known chemical and physical tests applied to the asphaltic cement, especially the penetration test which bears a particular relation to the pavement under the various conditions that may be imposed; there are permissible ranges within which the engineer may work safely and still fall short of the ideal in one or more of the requirements. The all important item is that he shall know within what limits he may vary the materials without detracting materially from the durability of the resulting composition. This fact is indelibly impressed upon the student of pavements when he notes that in localities where practically ideal materials exist, pavement failures occur because of violation of some fundamental principle. Failures do not occur without cause and the real cause of every failure is capable of determination.

Most of the failures which do occur in asphalt pavements are not due to any inherent defect in the mixture, but, are those common to most all pavement types, such as foundation failures, poorly drained subgrade, failure properly to replace the pavement over openings and others of a purely extraneous nature. This article will not discuss such failures as these, as they are usually the result of such flagrant violations of good engineering and sound economy as to be entirely without the realm of specialized knowledge and experience.

Defects Developed by Modern Traffic

Defects which develop in asphalt pavements under modern traffic conditions, consist almost entirely of surface displacement or movement, cracking and rare instances of ravelling. Cracking which may be attributed to the mixture itself is not common. The great majority of cracks in asphalt laid over rigid foundations is simply surface reproduction of cracks in the base. By "great majority" in this connection, I mean 95% or more. I have had occasion to investigate this feature at various times and each time I have been more impressed with a statement made to me several years ago by a man who had spent some thirty odd years laying asphalt pavements, to the effect that 99% of cracks in asphalt pavements were simply surface evidence of the cracking of the base.

Distortion Under Traffic

Distortion of the mixture under traffic is of two kinds, forward displacement and lateral displacement. The latter occurs on thoroughfares which are subjected to swiftly moving traffic, best described by the term "boulevard traffic." Forward displacement is developed under heavy traffic moving at a comparatively slow rate. There is another kind of distortion which is not due to any inherent defect of the mixture; this is the rutting which may be noted near the curb on asphalt streets which are constantly subject to standing motor car traffic. The drippings from the automobiles are responsible for this. In reality asphalt is not at its best under such a condition, and I am of the opinion that engineers should design the pavements in such cases with a brick or concrete strip next to the curb within the parking area. If the parking may be transferred alternately from the sides to the center, the effect of the drippings upon the asphalt will be greatly relieved.

Mixture Displacement

As mixture displacement has become prevalent and is by far the most objectionable defect that has developed under the changed traffic conditions during recent years, this discussion will be concerned largely with some of the principal causes of mixture distortion together with some of the cures which have been evolved through the medium of actual experience as well as theory.

Undoubtedly the most fertile cause so far as the mixture composition alone is concerned, is the use of too much bitumen and insufficient fine mineral or filler. Density of the mixture is of primary importance, and although it is not the only factor which affects the stability of the composition, high density does more to insure freedom from displacement than any other one thing, when it is accompanied by bitumen content just sufficient to coat the particles without any excess.

Securing Maximum Density

In order to secure maximum density, the first consideration is, of course, the reduction of voids to a minimum by means of a well graded aggregate. But, grading alone will not guarantee the desired result. It must be accompanied by the use of an asphalt cement of just as low a penetration as is possible without danger of cracking, having in mind the traffic to be carried; the rule being that the heavier and denser the traffic, the lower the permissible penetration, within certain limits. Climate is not nearly as important a factor in determining the penetration limits as is the traffic. In addition to this element, the mixing must

be very thorough and no segregation of the aggregate should occur as it passes from the storage bins to the mixer box. To insure uniformity, weighing of all materials must be accurate. And last, but by no means least, the laying operations must be such as to eliminate any possibility of mechanical defects which might afford a starting point for displacement. This will include proper distribution and raking of the hot mixture; good construction joints and other minor items, and above all, compression. The hot material is compressed to its ultimate density (practically speaking) under the first application of the roller. For this reason it is imperative that heavy rollers be used, and for the first rolling the three-wheeled type will be found to give much more satisfactory results than have been generally secured with tandem rollers. There are two chief reasons why this is true; the applied weight is greater per lineal inch of wheel width without any increase in the total weight of the roller; and, there is no crowding action under the roller, as with the three-wheeled type one wheel does not follow the other two in the same track. Three-wheeled rollers do not mark the surface by repeated application as much as the tandems do, for the reason that the compression is much greater under the first application. It is true that this type of roller cannot be handled as easily as the tandem and, therefore, its use should be confined to rolling in one direction without twisting, and should then be followed by tandems which respond more readily to cross-rolling, angle-rolling, etc.

Examples of Defective Mixtures

It is thought that comparison between actual examples of mixtures which have proven defective and others which have demonstrated their ability to withstand the traffic forces will prove of more value than a discussion of hypothetical cases, and for this reason a number have been selected from the records of actual investigations.

The first example of defective mixture is represented by two analyses of rolled sections. This pavement has been in service only a few years, carrying heavy arterial highway traffic in the vicinity of Chicago. The effect of heavy trucks during hot weather is apparent at a glance. This excessive rolling occurred only in certain sections of the road, and by no means could be called general; however, after driving over two or three sections like this, the occupants of the car would have a rather poor impression of this particular piece of asphalt pavement.

Bitumen		11.7%	12.0%
Mineral passing	200 mesh	12.7%	12.5%
Mineral passing	80 mesh	14.1%	13.0%
Mineral passing	40 mesh	27.5%	25.5%
Mineral passing	10 mesh	9.0%	8.0%
Mineral passing	4 mesh	18.0%	23.5%
Mineral passing	2 mesh	7.0%	5.5%

This mixture was apparently laid under a specification for Topeka type or a modification of the same, and it will be seen from these two analyses, taken from two different rolled sections, that about 3% too much bitumen was used. Any comment relative to the grading of the aggregate in this case is superfluous, since the most perfectly balanced grading could not possibly prevent distortion of such a mixture under heavy or boulevard traffic.

Another example of a badly rolled asphaltic concrete pavement is represented by the following analysis of a sample taken in an Iowa city:

Bitumen		11.2%
Passing	200	13.9%
	80	12.0%
	40	19.8%
	10	25.2%
	4	15.5%
	2	2.4%

Specific gravity of mixture—2.32

Again we find the bitumen entirely out of proportion. The specific gravity in this case seems relatively high and indicates good density; but, the virtue of density is destroyed by the excess of bitumen, which bears out a previous statement that density must be accompanied by the proper amount of bitumen. The underside of this sample was worn smooth from slipping on the concrete base.

Another example of rolled mixture is given below, and in this case a somewhat different condition arises, as the bitumen content would not have been excessive had the fine mineral been sufficient:

Bitumen		7.7%
Passing	200	7.1%
	80	4.0%
	40	11.6%
	10	18.8%
	4	33.3%
	2	17.5%

The most obvious defect in this mixture is the shortage of 80-mesh particles, which undoubtedly detracts from the stability of the structure.

Rutting may occur in a mixture which would ordinarily be considered fairly good for normal or moderate traffic. The case of the sheet asphalt pavement which rutted badly in two years of service under boulevard (or swiftly moving) traffic as given below, will serve to illustrate this fact. The first of these analyses is of a sample from a badly rutted section

and the second is from a portion which showed slight rutting at the end of four years, both from the same street:

		No. 1	No. 2
Bitumen		11.3%	11.7%
Passing	200	10.9%	14.1%
	80	23.4%	26.5%
	40	34.7%	33.9%
	10	18.2%	12.7%
	8	1.5%	1.1%
Specific gravity		2.14%	2.18%

Asphalt cement of 60 penetration used.

The higher gravity of No. 2 is easily accounted for by the fact that it shows a much more balanced grading than No. 1. While No. 2 carries slightly more bitumen than No. 1, the grading of the aggregate and the presence of more filler explains why it did not rut as badly as No. 1. Undoubtedly the penetration had a great deal to do toward encouraging the distortion of this mixture, as the pavement is not shaded at any period of the day. The penetration in this case should have been about 35 instead of 60.

Open binder had been used on this work, as was evidenced upon removing the samples; and at the time the samples were taken the concrete base was very damp, likewise the underside of the binder showed the effect of water action on a porous mixture to the extent that some of the stone was almost clean and the mixture crumbled readily in the hands. These facts concerning the binder should be stresed here for the reason that so frequently this very important integral part of an asphalt pavement is given only passing, if any, attention to speak of; whereas it should be just as carefully designed as the top mixture. While the binder permits of wider working limits as to grading, it must be well closed and dense, with no excess of bitumen. Also the coarse aggregate should be selected with a view to providing maximum interlocking of particles; in other words, uncrushed gravel will not produce as stable a mixture as can be secured by the use of 50% or more of crushed particles.

An interesting analysis, of an 8-year old sheet asphalt pavement from an Illinois city, is given below in order to illustrate the effect of a surplus of material of any one size upon the density of the mixture:

Bitumen		10.0%
Passing	200	15.2%
	80	45.6%
	40	10.7%
	10	.9%
	4	7.6%

This pavement cracked as might be expected from the shortage of bitumen with respect to the amount of mineral passing the 80 and 200 screens. The specific gravity of this mixture was 2.07, which shows relatively low density.

Now in comparison with the foregoing examples of mixture which have failed to give good results under the traffic which prevailed, a few analyses of mixtures which are giving excellent results will be cited with notations appertaining to such local conditions as are peculiar to each. The first example is two typical analyses of a sheet asphalt mixture designed for heavy traffic on a through street in the business section of a busy city in Michigan. This street carries the through trunk line traffic between Detroit and the Lake Michigan region.

Bitumen		10.4%	10.5%
Passing	200	17.7%	20.4%
	80	28.2%	25.3%
	40	32.2%	31.1%
	10	9.5%	11.7%
	4	2.0%	1.0%
Sp. grav.		2.18%	

These two samples show the extremes of grading during the entire progress of this work, and it will be seen that the mixture was indeed very uniform; about the only variation being in the percentage passing the 200 screen. This was due to the fact that the fine sand which was used in combination with a coarser one, varied from time to time in this particular. The sample showing 17.7% passing the 200 screen apparently contained no 200 sand, as this percentage agrees with the amount of filler required on this work; while the other sample appears to have carried over a little very fine sand. This work was laid on close binder carrying 35% of sand and 5.5% of bitumen. The foundation is an old brick pavement. Initial compression was secured by means of a three-wheeled roller.

Two other typical analyses are given from work in the same city for the purpose of showing what changes were made in the bitumen content to accommodate the various traffic conditions which obtained; the first being for moderate traffic and the second for light residential traffic:

		No. 1	No. 2
Bitumen		11.1%	11.6%
Passing	200	17.4%	20.9%
	80	25.1%	30.8%
	40	29.0%	30.8%
	10	15.1%	11.0%
	8	2.3%	1.3%

Numerous other mixtures both good and bad might be cited; and with a vast amount of such data for comparison, one is immediately impressed with the fact that in most cases pavement distortion under heavy traffic is due to the use of too much bitumen, insufficient filler, or a

combination of both. There are other causes of displacement, but they are much less common than this very important ratio of bitumen to fine mineral.

One case of very serious forward movement of sheet asphalt on a heavy traffic street in a large city, which I was called upon to investigate, was found to have been due to the fact that in resurfacing an old brick pavement (without binder course) the surface of the old brick had been heated and painted, while hot, with a cut back asphalt cement, in which the cutting agent failed to completely volatilize before the top was applied. This caused a fluxing action on the underside of the sheet top, producing an excellently lubricated plane of contact, which made rolling of the sheet a certainty. This condition was enhanced by the fact that condensation of moisture on top of the hot brick when the cold paint coat was applied prevented adhesion of the paint to the brick.

High Filler Content Now Essential

Filler content, which a few years ago would have been regarded as unnecessarily high, is essential in mixtures which are to be subjected to considerable traffic. This must be supported by a well graded sand, and the bitumen content must be consistent with the weight and volume of the traffic; as low as possible for heavy and dense light weight traffic, increasing as the weight and volume decreases. For a given bitumen content, the more fine mineral the mixture contains, the thinner will be the film of asphalt coating each particle, thereby reducing the possibility of the bitumen functioning as a lubricant during hot weather. An excessive amount of any one size, of even fine mineral, is of course dangerous, and constitutes about the only thing to be guarded against in designing a mixture with relatively high percentage of fine particles.

The foregoing paper was prepared by Mr. Skidmore for presentation before the 1923 meeting of the Iowa Engineering Society.

BENEFIT DISTRICT ASSESSMENTS FOR ROAD IMPROVEMENT

By M. W. Furr, Associate Professor of Civil Engineering, Kansas State Agricultural College, Manhattan, Kansas.

During the past four years the United States has expended approximately two billion dollars for rural road improvement. At the present time, there is some popular resentment against further expenditure for a unified system of highways because of high taxes. Notwithstanding the moneys spent for road improvement, a complete analysis of individual tax bills will reveal that only a small per cent of the aggregate is for good roads, and that special assessments are almost insignificant when benefits accruing are considered. However, protests are being made against the benefit district assessment method of partially paying for road improvement to the extent that building programs are sometimes retarded.

For several years municipal improvements have been partly or entirely financed by assessment against the abutting or adjacent property. State Legislatures and Courts have specifically recognized and passed repeatedly upon the theory of assessments according to benefits as equitable. Several methods have been satisfactorily used for the grading of assessment in order to distribute the cost of the project to the property in the district benefited.

The Area—Zone Method

The area-zone method is doubtless the most satisfactory for financing street improvement in which the per cent of zone benefits vary as the ordinates to a parabolic curve constructed on symmetrical axes, with the length of the abscissa equal to the width of the district. Data on the question as to whether or not the benefits accrue in this ratio is lacking. From the above about 72% of the cost of a pavement is assessed against the abutting property lying within one-half the width of the district, and 28% of the remaining one-half width. The districts are generally divided into four of six parallel zones and the weights used range between 45 to 60, 30 to 40, 17 to 20 and 5 to 13 per zone, respectively. The questions that arise are:

1. Can this plan of assessment equitably be applied to rural districts?
2. If so, where do the benefits fall and in what ratio do they feather out?
3. What per cent of the total cost should the district bear, and
4. Should a benefit district bear a fixed percentage of the total cost regardless of the type of road, or should it vary indirectly with the type or importance of the road?

Community Benefits

The question of community benefits accruing can not be denied as this is strongly apparent when a locality served with

railroad facilities is compared with one not so favored. In the same way the construction in any community of adequate highways of year-around serviceability for motor transport confers a real benefit to a community. A part of the cost of such an improvement might therefore be properly and equitably paid from a taxation of the district served. The possibility of the district profitably utilizing the facility will vary greatly wth the nature of the industries in the district and it is doubtful if any fixed percentage to be assessed as a general tax would be equitable for an area as large as a state. Differences in the assessed valuation of land, however, will tend to equalize taxation to a great extent even though the rate of taxation is uniform. There is also a direct and tangible benefit conferred on agricultural land by construction of good roads contiguous thereto. Lands on good roads are worth more than those not so situated and will actually sell more readily at a higher price. The land can be operated to show much better profits if located on improved roads, because of the facility with which it can be operated. Therefore, a certain part of the cost of a durable improvement can rationally and fairly be assessed against such lands. The percentage of the cost to be assessed is not easily determined. To my knowledge, two states, namely, Iowa and Kansas, assess the benefit district for 25% of the cost of the improvement.

Most Direct Benefit to Road Users

It goes almost without saying that the most apparent and tangible benefit from road improvement comes to those who travel the highway for business or pleasure and since about 95% of the tonnage on our highways is made up of various classes of motor vehicles, it follows that to them the benefit is most apparent. The cost for fuel, vehicle upkeep and the saving in time on improved roads are real and measurable benefits. Some tests of a preliminary nature were made at Ames, Iowa, to determine the differences in gas consumption on various types of surfaces. Very conservative conclusions were that 15% less fuel is used when traveling a high type surface. It is sufficient to say, therefore, that motor car operators will save $30 to $50 per year on fuel alone, a saving that can profitably be invested in road construction and maintenance. The amount that is added to the cost of the road because it must accommodate motor truck traffic can hardly be taxed against others than owners of motor trucks and it seems probable that in the future both motor trucks and passenger vehicles will be required to bear an increasing portion of the cost of road construction and maintenance.

For the above reasons it seems to me that a flat assessment of 25% of the net cost against the benefit district is excessive under the present conditions, especially for state road improvement where the pavement is designed for inter-city truck traffic. This does not mean necessarily that the percentage apportioned to the district is too high, but that the net cost against the district should be first reduced by deducting an amount to be borne directly by motor car operators. Our County Commissioners, assembled at Topeka in November, favored a state bond issue of $60,000,000, which obligation, if authorized, will be borne by motor vehicle revenues. Within ten years a state wide system of 6,575 miles of road can therefore be constructed without additional burden to the taxpayers.

Benefit Districts

The benefit districts in Kansas are generally less than two miles in width on each side of the road project to be financed. In sectionized country it is generally better to let the district feather out on a parallel line at the one-half mile point, thus fixing the width at 1½ miles. The reason for this is obvious. The original arrangement for land classification in Kansas is as follows: (1) CLASS A, all land bordering on road project. (2) CLASS B, all land whose nearest corner is one-half mile from the road project. (3) CLASS C, all land whose nearest corner is one mile (by passable road) from road project. (4) CLASS D, all land not included in Class A, B or C. (All parcels of less than 40 acres, and all railway sidings and station grounds are to be classed as the quarter section in which they are located. All railway main line right-of-way to be classed in Class D).

Method of Figuring

In the first method of figuring, the relative benefits are assumed to accrue in the ratio of 45, 30, 17 and 8 per zone, respectively. The uniform tax factor is determined by dividing the total tax to be raised by the summation of the products of the zone valuations multiplied by their respective weights, and the zone tax rates are then found by multiplying the uniform tax factor by the respective zone weights. Individual assessments are

found, then, by multiplying parcel valuations by the zone tax rate.

The second method of figuring is identical with the first except that zone areas are used and the tax rate per acre similarly determined.

A third method which is similar to the second method, but with broader application, has been recommended for use by the Kansas State Highway Commission. The acre is taken as the unit, and the land is classified in zone 1, 2, 3, 4, etc., for distances of one-quarter, one-half, three-quarters, one mile, etc., from the road. The unit area is assumed to receive 100%, 80%, 70%, 50%, 40% and 30% benefit, respectively. Relative weights now become 10, 8, 7, 5, etc., and each zone assessment factor is found by dividing the product of the zone weight multiplied by the total tax to be raised by the summation of the product of the zone areas each multiplied by their respective weights.

For comparison of results of the three methods of figuring see the accompanying table. Principal data taken from Gravel F. A. P. No. 2, Labette County, Kansas; 25% of net cost to be raised is $11,863.74. Approximate cost per mile at $9,600; valuations taken from records of county clerk.

			—Assessments—		
	Valuation	Acreage	1st Method	2nd Method	3rd Method
Zone					
1	1555	40	$46.80	$58.53	$50.42
2	1555	40	31.19	39.02	40.33
3	1555	40	17.68	22.11	35.29
4	1555	40	8.32	10.41	25.21
1	3905	80	117.54	117.07	100.84
2	2900	80	58.17	78.04	80.67
3	2590	80	29.44	44.22	70.59
4	3805	80	20.36	20.81	50.42

For further comparison the following data pertaining to paving F. A. P. No. 1, was submitted by Ira E. Taylor, County Engineer of Mitchell County. The assessments were determined by Method No. 1. Land and improvement valuations were placed by a board of appraisers. This pavement cost approximately $45,500 per mile with a total district apportionment of $76,267.39. The relative benefit weights assigned to the zones in this example were in the ratio of 45, 30, 20 and 5 and the assessment per zone per $1,000 assessed valuation computed to be $44.89, $37.22, $23.23 and $10.26, respectively. Railroad right-of-way was assessed as private property in whatever zone it was located. Under this method of figuring the approximate average assessment per acre per zone would rate at $4.80, $3.90, $2.20 and $1.00, respectively.

Point Method Used in Iowa

The point method of figuring is used in Iowa which, in my judgment, is a very commendable method. The Board of Apportionments are instructed to rate all parcels under the heads of (1) Market value (one point is assigned for each $25 valuation per acre), (2) Proximity, (3) Accessibility, (4) Productivity, and (5) Location. The total points per zone generally sum up so that the zones are assessed 41%, 28%, 18% and 13%, of the net total district apportionment, and for a graveling project a one-acre tract would be charged $2.10, $1.50, $0.97 and $0.68 per zone, respectively.

By careful comparison of the results obtained by distributing the assessments by the three methods mentioned above, it will be noted that the first method cannot readily be compared with the others because of variation in the valuations. The results obtained by this method will be consistent with the general tax assessments; however, adjacent property of the same acreage will be assessed differently. Railroad property was originally incorrectly classified but this has been adjusted in the present plan of figuring; namely, the third method mentioned above.

Insofar as the benefit assessment source of revenue is concerned, I believe that the public contention is because of the seemingly inequalities, rather than a criticism of the amount expended in this way for highway improvements. What then, is the equitable method for distribution of cost,—who is to pay and how much, or what percentage of the total expenditure for good roads is to be disbursed by the different sources of highway revenue?

The foregoing paper by Professor Furr was presented at the meeting of the Kansas Engineering Society at Topeka on Dec. 14, 1922.

EXPERIENCE WITH CITY MANAGER GOVERNMENT AT SACRAMENTO, CALIFORNIA

By C. L. Seavey, City Manager, Sacramento, Calif.

In Sacramento, a year ago the first of last July, the new charter took effect, putting in a city manager as the responsible head of the administration of the city affairs. Generally, the duties of the city manager included and took over the executive functions of the city. There

were, in a few instances, omissions in the powers of the city manager in Sacramento that may be remedied or may not, in the future, which interrupt, to a slight degree, at least, the ability of the city manager to control all things in the executive end of the city's affairs.

I was nominated and selected by the City Council about a month before the new charter took effect—the latter part of May. I immediately got hold of a person who had had a good deal of experience in both municipal and state affairs. from the standpoint of organization, and, together with him and one whom I had selected to take the office of City Comptroller, we made a survey of the existing organization in Sacramento at that time, and built up a new organization in accordance with the provisions of the new charter, and in accordance with our belief as to what the organization should stand for.

Force Cut, Salaries Increased

In so doing, we eliminated from the payroll of the City, taking effect as of July 1st, something over $43,000 in salaries alone. By that I do not mean that we lowered salaries. In fact, we lowered no salary; we raised many salaries, and some of them were raised very considerably. But, as a net result, we saved about $43,000 in annual salaries in reorganization. And since the first of July a year ago, we have saved additional amounts above the original $43,000 in the salary item. It was very gratifying to us at the end of the year's period that it was demonstrated that our original survey was within reason, and practically what was necessary in carrying on the affairs of the municipality.

As to what we have accomplished in Sacramento, I do not speak in any vain way, because it was there to be accomplished, and was rather easily done. What we accomplished, has been accomplished in nearly every municipality that has changed to the manager form of government. And to a great extent the reason for the accomplishment is that it is a better form of municipal government than the others. To my mind it is the best form of municipal government, both theoretically and practically, that has ever been attempted in the United States.

The first year we reduced taxes by approximately $123,000, and provided for more actual work to be done in the way of street improvements and street cleaning and things of that kind, than had been done before.

At the beginning of July, 1921, that being the middle of our fiscal year, we found a deficit of something like 20% in the available funds of the municipality. That is to say, for the remaining six months we had to run on about 40% of the year's appropriation, and the records which we kept showed that we accomplished more work in proportion with that 40% than had been accomplished on the 60% in the first half of the fiscal year.

That again is not necessarily a matter of credit to any individual. I ascribe the largest share to the fact that the funds and the operation of the city's affairs could be handled more easily, more directly, and more economically, because of the form of government, because there was no overlapping of departments, because there was actual, absolute coordination between all the departments, for the reason that there was direct responsibility to one head on the part of all city heads of departments and city employees.

And there was no question about what that meant. It meant that we got results for every dollar expended. And results were what we were looking for. We were not looking in any way for any political manipulation or machination. That is one of the things that cannot be avoided in other forms of municipal government. There is no use talking about it, it is absolutely necessary in some forms of government, even to accomplish good in the government, to manipulate politically, and that is always at the cost of efficiency and economy in any government.

At the end of the first year, which was the first of July last, when we had operated six months under the old budget and six months under the new budget, which was drawn after we went into office, I found that we had actually operated a year for $103,000 less in operating cost of the same functions of the City's affairs, than the government had been operated the year previous. And the records show that, as I have indicated before, we have accomplished more actual work, more streets repaired and such things, than the year previous. That again was because there was the possibility of a properly working organization.

We reduced the fire hazard in Sacramento. The fire losses were reduced 80% in the year. About a year ago last July, a survey of the City was made by the fire

department, which had not been made for years, and a consistent follow-up in fire prevention was put into effect, and to a large extent, I believe, was responsible for the very small percentage of fire loss in comparison with that of previous years.

Moral Questions

We have had our troubles. In the police department particularly, I find the opening for trouble for a city manager. The moral questions that must be handled through that department are quite a problem—they are a problem in any city. But we have accomplished considerable there, I believe, because of the fixed responsibility and the direct action on the part of the department through a responsible head. In fact, I know that we have practically eliminated the selling of drugs, where they were being sold promiscuously over a year ago. That has resulted in the reduction of petty crime, a big reduction in petty crime, in Sacramento.

The matter of liquor enforcement is another very difficult thing, because, in the minds of many people, it is not a thing to be desired entirely; and where you find in the public mind a non-desire or undeveloped desire to believe in a certain law that is on the books, it is of course impossible properly to administer that law. And yet the outward evidences of that have been eliminated, to a large extent. I might put it this way, that what might be called the vulgar and open evidences of it have been largely eliminated from the streets of Sacramento where they were very evident prior to the new administration.

We offered for adoption a little Volstead Act, but the people did not want it. So we went ahead the best we could with such means as we had at our hands, in co-operation to a certain extent with the Federal officers, unsatisfactory to a large degree, but we simply hammered away. You all have those problems, and probably the problem is just as difficult with you, and more difficult where you haven't the manager form of government.

We took over the garbage collection in Sacramento, and in the first year of operation we have put it on a paying basis, and from the operation of the garbage department, based on the charges that were in existence before the City took it over, we have made a saving. We netted a saving of a little over $8,000 in the first eight months of 1922. We purchased equipment at a cost of about $12,000, and by the end of 1922, we expect to have nearly if not wholly eliminated the cost of the equipment, and to have conducted the department in a manner practically satisfactory to the City. In evidence of this, before we took it over, the complaints from garbage collections were coming in at about the rate of 100 to 110 a day. They are now coming in, and have been for several months past, to the extent of 10 to 15. We never expect to eliminate them, but we believe we have reduced them very appreciably, perhaps to a minimum.

In the way of legislation, the Council has put over some excellent municipal ordinances, perhaps one of the best milk ordinances of any city in the state. There has been put into effect a traffic ordinance from which remarkably good results are coming, and our zoning ordinance is now nearly through its initial hearing. We have also followed stricter building restrictions, and they have proven that they were sadly needed.

General Observations on Manager Form of Government

The history of the operations in Sacramento, as I said, has been quite similar to that in other cities in the United States and Canada, where they have this particular form of government. To my mind, there has been a remarkable proof of efficiency in the growth of this form of government, proving it to be a more practical form, and better form for municipalities, than others that have been attempted. It has demonstrated by its growth that there is real merit in the method. Since 1913, nearly 300 cities, either by charter or ordinance, I think about 200 by charter and a little less than 100 by ordinance, have adopted this form of government. This is a remarkable record of growth in the establishment of any governmental method in municipal affairs. Another remarkable thing about it is that no city of which I have knowledge that has adopted it by charter, has ever receded from it. I believe there were few small cities that repealed ordinances for city managers, or partial city manager forms, but those were for reasons other than that the system was not a good one. A number of cities of very small populations felt that they could not afford to have a person salaried high enough to take over the duties.

Manager Form Fundamentally Sound

The reason, to my mind, that this is proving a good system of government, is because it is fundamentally sound. It is builded upon the same principle that our form of national government is builded,

and our state governments, and that is the separation of the legislative and executive functions of the government. Our municipal governments, outside of the manager form of government, have always been an intermixture of the legislative and executive powers. Our forefathers, in adopting the constitution of the United States, and our different states, in adopting the several state constitutions, have been far-sighted enough to provide that the three distinct functions of government, the legislative, the executive and the judicial, should be kept separate. The fault in our municipal affairs of the past does not lie with individuals, except to a minor extent. Individual frailty is not the reason that our municipal governments have been declared by experts to be the worst form of government in existence. It has been because the principle of our municipal government has been wrong. All signs point to the fact that the municipalities of the United States are coming, and will rapidly come, to the point where there will be an elimination of the mixture of legislative and executive duties in municipal affairs. Not until then, in my belief, will we have the kind of municipal government in the United States that we ought to have. There is no one who would think of electing legislators and sending them to the State Capitol to enact laws for the state, and then having them take over certain functions of the executive branch of the government, divide it up among them, and operate along the lines and under the laws that they themselves have sponsored. It would be unthinkable to do such a thing, and yet this is what we have been doing in the municipalities, practicaly in all the life time of the United States. But to my mind, it is simply an attempt to apply a principle of government that cannot be applied sucessfully, and that has made the United States the laughing stock of the world as to the conduct of her municipal affairs.

There are problems in the matter of a city manager form of government that have not yet been worked out. It may be that there will need to be changes in the methods that now exist. But the general principle must be adhered to, if we are to continue to advance in municipal government in the United States.

In Sacramento, our charter specifically separates the legislative from the executive branch. The Council is a legislative body, and it is prohibited by the provisions of the charter from interfering in any way, directly or indirectly, with any appointments of the city manager, or any operations of the departments under the city manager.

Civil Service Under Manager Government

In the matter of civil service, it has frequently been stated in print and in public address that the city manager form of government and civil service are absolutely antagonistic to each other, and that the city manager form of government could not exist unless civil service was eliminated. I don't believe that. There are different kinds of civil service. A proper kind of civil service can operate and be of immense value under the manager form of government, as well as it can under any form of government. I believe that civil service as a method of qualifying people for positions and employment is a necessity under the city manager form of government., and a necessity for proper administration under any form of government. Neither the city manager nor any one else appointing should be in a position where he could absolutely personally control all of his appointments; not his appointees, mind you, but his appointments. I believe that he should, for his own benefit, as well as for the benefit of the public and the administration, be compelled to go to a qualified list to appoint. But I do not believe that the city manager, or any other executive, can properly carry on the duties of his office, unless he has the right under proper restrictions, to remove his appointees. I do not believe that any appointing power should have the right to arbitrarily remove an appointee. But I believe that he, in some public way, should be the only one to determine whether or not an appointee should remain under his administration. If the city manager, or any other appointing power, is qualified to hold his office, he must be qualified to give substantial justice to any one who is appointed by him or working under him. If he is compelled, in retiring any one from the service, to go to a board and submit to their decision as to whether or not that appointee shall be retired, it places him in an impossible position to get proper results from appointees when they are not retired. And if an appointee is given certain rights, which I believe he should have, and which he has under some forms of civil service, he will be protected as far as he should be protected in his employment.

Now, there are two methods of civil service. One is founded upon the belief

that the person serving should be protected in his employment against his employer. The other is founded upon the belief that public service should be standardized and protected. It is not generally known, but under our state civil service, the appointing power may appoint only from a qualified list, and may remove and determine for himself whether or not the appointee shall be removed. But he must make that determination a matter of public record. A public hearing must be had if it is called for by the appointee that is to be removed. That seems to me to give any appointee sufficient protection against an improper removal. If the appointing power is willing, in a public hearing, to take up the matter of the removal of an appointee and make it a matter of record, it is a sufficient safeguard against his being improperly removed. Any public official who appoints should have the privilege and right to remove in that manner, and I do not believe you can get efficient management under any form of government without that. I have been accused on several occasions of being against civil service. I am a member of the State Civil Service Commission, and I believe in civil service. But I do not believe civil service is made just to keep people in office.

City Manager Not an Autocrat

The charge of autocratic power has been made against the city manager form of government. In answer to that, I wish to say that this same charge can be made just as truly against any official who is in any government service as an executive, under any form of government. I fail to see how any executive, under any manager form of municipal government of which I have knowledge, can be autocratic. He may be unpopular, he may be neglectful, he may be inefficient, but certainly under the city manager form of government a city manager cannot be autocratic, because he has not legislative powers.

A city manager operates under the ordinances and the laws governing his municipality, and simply carries out, or attempts to carry out, those laws. An autocrat is one who can arbitrarily inflict legislation upon a community or upon a state, or upon a nation, and enforce it without recourse. But the city manager is to a large extent an automaton in carrying out those policies, those restrictions, and those activities that are set before him. The complaint that the city manager may becoce autocratic falls also, it seems to me, because the city manager, more, I believe than any other kind of city executive, comes in direct contact with many citizens. The entire responsibility of the operation of the municipality governmentally, after the council has acted, is directed to the city manager. He is the target of every individual in the community. And any one who is subjected to that would not attempt to be autocratic, nor could attempt it, even if he had autocratic powers, because he is under constant surveillance by the community. The charge that a city manager form of government may become autocratic, is simply one of those charges that is raised against any new thing that may be presented for the approval of the people.

The Personal Equation

The personal equation in the city manager form of government cuts quite a figure. As I said a while ago, every individual in the city knows that the city manager is responsible if something is not done. He does not go to a commissioner and have that commissioner tell him that some other commissioner is responsible, and in that way go the round of the commissioners, and then be told finally that the commission as a body is responsible. If something is not done, if his street is not fixed, if his street is is not swept, if something is not taken care of that should be taken care of in the municipality, the offended person goes to just one man in the municipal government, and that is the city manager. He knows that the city manager is responsible; that he cannot evade his responsibility. In that lies the virtue of the city manager form of government—responsibility for the proper conduct of affairs, the proper expenditure of the moneys appropriated for municipal purposes, rests continually upon him. All individuals or groups of individuals in the community who ask for something and are given it in the budget, know what should be done and where and when it should be done, and they can go to the one individual and find out why it is not done, and why the money was not expended, as it should have been expended.

The Budget

That leads me, lastly, to the matter of the budget. I would not be willing to be city manager of Sacramento or any other city, if I did not have a budget provision in the charter. The city cannot properly operate and properly function without a budget.

When I came into office, there had been a budget prepared, not under the provisions of the charter, and in going back over the operations under that budget, it is almost impossible to find where they had followed the budget, except where their salaries were fixed. For the year previous to the time when we came in, there had been $15,000, I believe it was, allocated to permanent street improvement, and we could not find that more than about a thousand dollars had been expended for permanent street improvement out of the fund in that year. And there were other things of like nature. Where you haven't a budget there is switching and maneuvering. We prepared a budget last July, that is, July of 1921, for the City of Sacramento under the charter. That budget is being followed during the present fiscal year which started the first of last January. I would not say that the new budget, which was prepared without very much previous experience in municipal affairs in Sacramento, was anywhere near perfect. It was not. There are lots of things about that budget that were improved upon this year. Under the charter we have a provision which gives the council the right to transfer from one department to another. No money can be transferred from the fund of the department to which it is appropriated without an ordinance passed by the city council. We have operated under our budget provision up to this point, at least, this year, without transferring any money from one department to another.

I thoroughly believe that a budget must be adopted in order to get proper results in any municipal government; that it must be known to the public what the budget contains. Those who prepare the budget are constantly upon their mettle, not only properly to prepare the budget, but properly to follow it. The people are entitled to know what their money is going to be expended for, except in matters of emergency that come up after the making of the budget; they are entitled to know whether or not their streets are going to be improved, and their water mains taken care of, and so on, down the line. And if money is not needed in a particular budget item, they are entitled to know that. If the money is to be used otherwise they are entitled to knowledge through legislation by the council, so that there can be no question of the proper use of the money; so there can be no question that a department is not deprived of something that it should not have been deprived of, and that the money is being expended for a purpose that is necessary. Under a proper budget system, that can be accomplished, and the funds of the people of the city better safeguarded, and expended under a better balanced method than in any other way.

PLANT AND METHODS USED IN BUILDING MILE CONCRETE ROAD PER WEEK

Mile-a-week concrete road building has been made a reality by the Aaby-Maturi Company of Chisholm, Minnesota, paving on a section of the Miller Trunk Highway betwen the Mesaba Range and Duluth.

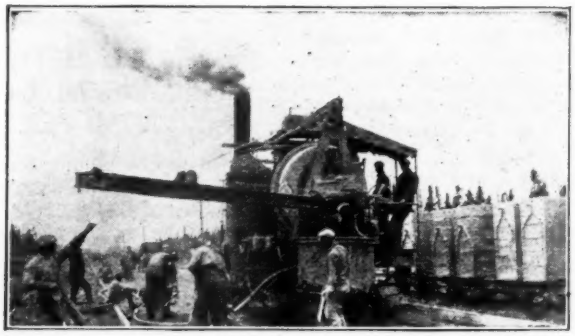
The Aaby-Maturi Company has been building concrete roads in Minnesota for a number of years. The construction recently completed included 15.1 miles of road beginning at Martins' Siding and extending towards the Mesaba Range. Although these contractors were also awarded the contract for the construction at the same time of a section from Eveleth to Central Lakes; the sections were some distance apart with the result that it was necessary to lay out two complete plants differing only in details.

Construction began on May 8th and was completed September 2, 1922. During this period many performance records were made and they are the more remarkable considering that the mixer was of the usual 21 cu. ft. size and not one of the larger sizes. Throughout the construction period a weekly average of 5,125 ft. per week was attained. The daily average over this extended period (a season's work) was 855 ft. The highest daily run was the paving of 1,260.6 ft. of road. On twelve different days 1,000 ft. or more were constructed.

Frank Aaby and Raymond Maturi, partners in the Construction Company, personally supervised the work. R. W. Acton, Chief Engineer of St. Louis County, was the engineer in charge and under him were Peter Huntington, Chief Inspector of Miller Trunk Highway. and four men in direct contact with the engineering and inspection work.

A gravel pit where raw material was washed and screened to provide the necessary sand and pebbles, was located in the middle of the work. At this ideal location of the aggregate, a central proportioning plant was built. Cement was received on sidings at Alborn and Mar-

tins, and during the laying of the road from the far end to the center it was transported by the industrial railway to the central proportioning plant. After the construction work reached the proportioning plant, the cement was stored in a house on the subgrade which was moved twice a week. The paver was charged from batch boxes brought up on cars by locomotives on the industrial haulage system. With the establishment of the central proportioning plant at one point, the expense of moving the plant was eliminated and it was only necessary to move the industrial haulage system.



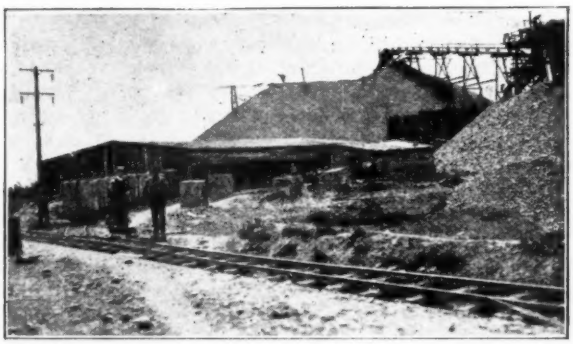
SMITH 21-E PAVER WHICH LAID A MILE OF CONCRETE ROAD EVERY WEEK ON AABY-MATURI CONTRACT BETWEEN MESABA RANGE AND DULUTH, MINN.

Concrete Slab Specifications

The slab was constructed according to the 1922 specifications of the state of Minnesota. The pavement is 18 feet wide, 7½ in. thick, with steel rod reinforcement. The mix is 1-2-4; that is, 1 part of portland cement, 2 parts of fine aggregate and 3 parts of coarse aggregate.

Batch Box Loading Plant

The loading or proportioning plant, as before mentioned, was placed at the gravel pit in the center of the contract. The gravel was excavated by steam shovel and loaded into small bottom-dump cars which were hauled by cable to the foot of the screening and washing plant where the contents were dumped and raised by bucket elevator to the top of the plant. Oversize stone was returned to the pit. Sand and coarse aggregate was moved by cars on trestles and belt conveyors and dumped onto stock piles over separate charging tunnels. The sand tanks, revolving screens, elevators and washing equipment were of the Telsmith type and were furnished by the Smith Engineering Works. Ample capacity was provided in the plant and at times as much as 12,000 yds. of coarse aggregate was available in the stock piles.



CENTRAL PROPORTIONING PLANT AT GRAVEL PIT SHOWING CHARGING TUNNEL AND CEMENT SHED, AABY-MATURI CONTRACT.

The batch box cars were spotted under the hoppers in the sand and gravel loading tunnels and the boxes filled from improvised batchers. Cement was also added at this point or later in the job

from a shed placed on the subgrade. With aggregate supplies at hand locally, no dependence was placed on railroad transportation except forcement and the railroad strike failed to affect the progress on the work.

To accomplish the remarkable progress made in the construction of this pavement, it was necessary that the paver be mixing material practically continuously. In order to accomplish this it was necessary that sufficient material be available not only in the stock piles but in batch boxes at the paver. American batch boxes holding 37 cu. feet, of material were used with 8 cars to a train. Another factor almost as important as having the materials available was the perfect coordination between the batch box derrick and the loading skip of the Smith Paver used on the work.

When the loading skip was raised the batch box which had just been emptied into the skip was lowered back onto the car and the hoisting bale hooked to the next box. With the lowering of the skip the batch box which was counterweighted with it was raised clear of the car and the bail bearing derrick boom swung over the skip to put the box in position for emptying. These automatic functions required no attention from the paver operator.

Material Haulage

Koppel cars with two 37 cu. ft. boxes to each car were drawn to the mixer, 8 in a train, by 5 Plymouth 7-ton locomotives. A pusher locomotive was also used on heavy grades. Light weight industrial rail laid on wood ties was used, the road shoulder serving as roadbed.

The concrete was mixed and placed on the sub-grade by a 21-E Smith Paver, manufactured by the T. L. Smith Company, of Milwaukee, using a 5 bag batch of 1-2-4 proportions. The mixer traveled under its own power on full length traction. Concrete was placed on the sub-grade by means of a boom and big cross-dump bucket distributing device. The coordination of the various operations of the paver was given credit by the contractors for much of their succes in laying a mile of pavement a week.

Water for mixing the concrete and also for sprinkling the completed pavement during the curing process was pumped an average distance of 2½ miles from the St. Louis and Cloquet Rivers.

TEAM SCRAPERS ON COARSE GRADING AND ROLLER WITH SUBGRADER COMPLETING FINE GRADING ON SUBGRADE, ON AABY-MATURI CONTRACT.

Finishing

The fresh concrete after being laid in a ribbon on the subgrade by the bucket traveling along the boom of the mixer was further spread by men with shovels and rakes. A machine finisher then struck off to proper level and tamped the wet concrete, and by means of an oscillating belt gave the concrete the final surface finish.

Curing was accomplished by covering the newly laid concrete with earth. The earth was then sprinkled daily and served to hold the moisture to the surface of the concrete.

Workers' Quarters

Nearly 120 men were required to handle the proportioning plant, haulage system,

grading, paving, finishing and curing. Some of the crew came from nearby towns while others coming from greater distances had to be accommodated in a company camp. The camp buildings were erected at the gravel pit and proportioning plant. A portable camp for the paver crew was mounted on skids on the subgrade and moved several times each week. The men were charged only enough board to pay actual expensees.

The Aaby-Maturi Company in this piece of work have convincingly illustrated what it is possible to accomplish in road-building efficiency through a careful study of conditions, careful planning and organization, and the selection of standard equipment.

THE ECONOMIC VALUE OF HIGHWAY TRANSPORT FRANCHISES

By Arthur H. Blanchard, President National Highway Traffic Association and Professor Highway Engineering and Highway Transport, University of Michigan, Ann Arbor, Mich.

What is a highway transport franchise? Although the phrase "Highway Transport Franchise" has not been officially defined, it may be explained, as used in this paper, in order that the discussion of this topic may be intelligently comprehended. A state highway transport franchise constitutes an agreement between a state controlling body, as the party of the first part, and the highway transport operator, as the party of the second part, covering a guarantee of definite service on a prescribed route under stipulated conditions by the highway transport operator and a guarantee by the state that there shall not be unwarranted, ruinous competition by other highway transport operators.

Highway transport operators operating under franchises are motor vehicle common carriers, as they carry indiscriminately, within reasonable limitations, all persons or commodities, under general conditions of agreement applicable to the whole public, on defined routes according to definite service schedules.

Highway Transport Services Subject to Franchise Control

For example, it is evident that the highway transport services rendered in accordance with the following definitions may be covered and controlled by highway transport franchises:

Rural Motor Express pertains to the highway transportation of commodities on defined routes according to service schedules from several producers in a rural district to a terminal with or without return loads being carried from the terminal to the producers or other consumers.

Intercity Motor Express pertains to the transportation of commodities on defined routes between municipalities according to service schedules with or without service being rendered at intermediate points.

On the other hand, it is believed that the following defined services cannot efficiently or legally be covered by franchises:

Long and Short Rural Haulage includes all highway transport methods which utilize highways outside of municipalities except intercity haulage and highway transport operating on defined routes according to service schedules.

Intercity Haulage pertains to highway transportation of commodities between municipalities except highway transport operating on defined routes according to service schedules.

The same conclusions apply to the commercial transportation of persons.

The legal right of the state to control the operations of common carriers is generally admitted except in the case of interstate common carriers. At the present time, at least 22 states provide in their statutes for some degree of state control over motor vehicle common carriers.

Are highway transport franchises an economic and public necessity? To those familiar with the development of the commercial transportation of commodities and passengers by motor vehicles during the past 15 years in the United States and the longer history of highway transport in Great Britain, the answer is unreservedly in the affirmative.

Highway Transport Failures

Failures of highway transport enterprises are occurring every day due to a lack of knowledge of the fundamentals of the economics, science and art of highway transport. It is reported that 90 per cent of all highway transport companies doing business with New York City as a center fail within three years after entering this field. While 50 per cent may fail due to cut-throat competition by fly-by-night companies, it is conservatively estimated that at least 50 per cent fail because of lack of knowledge of the A B C's of efficient highway transport business methods, cost accounting, management, and the operation and maintenance of equipment. Those interested in the eff-

cient development of highway transport in the United States have a big task before them in bringing to the attention of groups of business men or capitalists, operators and prospective operators of highway transport, the necessity of having connected with their operating organizations men who are thoroughly trained in the methods of highway transport, the interrelationship of highway, railway and waterway transport, highway transport legislation, the fundamentals of highway transport cost and record systems and the principles of highway transport management, together, of course, with a knowledge of the mechanism, operation and maintenance of motor trucks, tractors and trailers.

Protecting Responsible Operators

As an integral part of the essential transportation system of America, it is absolutely necessary that highway transport be placed upon a sound business basis in order that responsible operators may be protected and that this branch of common carrier service may be conducted in such a manner as will guarantee to the public constant, efficient, economic service.

From the standpoint of public safety, the state must insist that our motor vehicle common carriers transporting passengers provide a maximum degree of safety to the traveling public and eliminate reckless driving by inexperienced chauffers and the utilization of wholly inadequate motor vehicle equipment which may be characterized in some cases as a piece of junk carrying a packing box in which persons are jammed, the resulting contrivance being called a motor bus.

State Regulatory Powers

Based on an analysis of all state statutes covering the control of motor vehicle operation, the powers given to state public service controlling bodies may be classified as follows:*

1. Grant, refuse to grant, amend or revoke Certificates of Public Convenience and Necessity.
2. Prescribe routes.
3. Fix schedules.
4. Determine character of service and promote the comfort and safety of traveling public.
5. Establish fares and rates.
6. Require reports and uniform methods of accounting.
7. Examine accounts and records.
8. Supervise fiscal affairs such as incorporation, capitalization of stock, etc.
9. Compel additions to, extensions of or betterments in physical equipment.

Qualifications of Regulating Board Members

If the powers enumerated are given to a state controlling body, what should be the qualifications of the members of such a body? It is evident that a grave responsibility to the public and to highway transport business will rest upon them. They should be men possessing vision, judicial minds, and a broad knowledge of transportation, and should be unprejudiced pertaining to the relative development of railway, waterway and highway transport. Different fields of public and business affairs should be represented. An efficient controlling body might be made up of the Attorney General of the State as an ex-officio member; a highway transport man of high standing and possessing a broad knowledge of the development of all phases of transportation of commodities and passengers by motor vehicles; an experienced highway engineer, who understands the fundamentals of highway transport and who thoroughly comprehends the relationship existing between the economic operation of highway transport and such highway factors as grades, alignments, widths, drainage, foundations, the character and maintenance of roadway surfaces, and the methods of controlling and directing the operation of traffic on highways; a business man who has dealt with big commercial problems; and a banker who is familiar with the practice of bonding common carriers and other enterprises in connection with the operation of which the public must be protected. To this group of five might be added a steam railroad man and an electric railway man provided that they possess a broad vision relative to the development of transportation in America, such as is possessed by W. H. Lyford. His comprehensive knowledge of the transportation problems of the United States was shown to the public through the medium of his admirable address before the Second National Conference on Highway Engineering and Highway Transport Education in Washington in October, 1922, during which he vividly outlined the many fields of railway transportation in connection with which highway transport may be efficiently employed and how the improvement of highways and the development of highway transport is of direct benefit to the rail-

*Report by Motor Vehicle Conference Committee, March 1, 1922.

roads. At least 90 per cent of the railway officials of the United States could profitably digest Mr. Lyford's conclusions with the result that many would be converted and in the future would not exhibit that narrow-mindedness which has led many to protest vigorously against the use of railroad taxes for highway improvement, and the development of highway transport.

In conclusion, it may be said that, in the opinion of the writer, the highway transport operator of sound financial standing, who is endeavoring to render to the public an efficient, economical and safe transportation service, will welcome the passage of state laws relative to highway transport franchises provided that they are based and administered on the principles which have been herein outlined.

The foregoing paper was presented before the Joint Session of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association at Grand Rapids, Mich., Nov. 2, 1922.

RELAYING 23-YEAR OLD BRICK IN NEW PAVEMENT AT LYNCHBURG, VA.

By Boyd A. Bennett, City Manager of Charlottesville, Va., formerly Commissioner of Public Works, Lynchburg, Va.

Lynchburg, Virginia, in the summer of 1922 made good use of the salvage value of the old, though slightly worn brick, in the reconstruction of a 23-year-old brick pavement that was approaching the limit of its usefulness. By so doing we have today a brick pavement that should give good service for the next 30 to 50 years unless there is a radical change in amount and character of residential street traffic.

By turning over the 23-year-old brick and relaying them on a more substantial foundation we have a smooth, durable pavement, and that too at a cost much less than that of a new pavement.

Lynchburg has been laying brick pavements since 1892. Two 30-year-old streets are still in good condition today and rendering satisfactory service. Another 27 years old is entitled to the same classification.

Madison Avenue is the street on which we decided rejuvenation of the pavement was necessary. In 1899 the brick were laid on the natural soil of a gravelly clay character which had been given a thin cushion of clean sand. Sand filler was used. Cost of construction was $1.20 a square yard.

The brick in the original pavement were miscellaneously assorted. The engineer at that time demanded an unusually high quality of brick, measured by standards of that day. It was impossible for the manufacturer to meet the requirements fully, so that finally the quality standards were reduced after the job was partially completed, and the manufacturer put up a bond guaranteeing the quality of his material.

In spite of these considerations no maintenance was required for 23 years except that incident to replacing cuts and openings. Modern traffic conditions brought about the necessity of improving the alignment of the surface which had become rough due to lack of substantial support of the wearing surface.

FIG. 1—VIEW OF 23-YEAR-OLD BRICK PAVEMENT IN LYNCHBURG, VA., PRIOR TO RECONSTRUCTION.

A selection from three possible methods was open to Lynchburg in improving the condition of Madison Avenue:

1. Build a new pavement.
2. Use the old brick pavement as a base, for some bituminous wearing surface.
3. Use the brick themselves in a reconstructed pavement.

We carefully weighed the possibilities of each of the three methods, holding the first named as a last resort. We studied the experience of other communities in respect to the other methods named, but from the standpoint of first cost, as well as later maintenance costs and durability. Our studies, both at home and abroad, convinced us that no proposition had in it the elements of economy offered in the continued use of the brick already in the wearing surface on Madison Avenue. While collectively the brick were out of order, individually they had a high salvage percentage.

FIG. 2—STREET NARROWED, BRICK CLEANED AND RELAID READY FOR ASPHALT FILLER.

At the request of property owners it was decided to cut down the width of the street from 46 to 27 ft. between curbs. Upon removing the brick a careful examination showed them to be in good condition.

The design determined upon provided for a 4-in. concrete base, sand-cement bed, use of the old brick, and asphalt filler.

Fig. 1 shows the street before new construction was started. A slight unevenness can be noticed in spots, also some of the brick are cobbled.

Fig. 2 shows the concrete base complete and the brick relaid prior to application of the filler. This picture reveals the good condition of the brick and the smoothness of the surface.

In removing the old brick we used common labor. The brick were torn up with crowbars and conveyed to the side of the road on roller conveyors, the conveyors cutting the cost of handling and also serving to help clean the brick.

The excavation was done by teams, plows and labor, using trucks for transportation. The excess dirt was hauled from one-half mile to one mile.

Slag was used for the coarse aggregate in the concrete base ranging in size from ⅝-in. to 2¾-in. The mix was 1-3-5.

The cost of cleaning the brick was more than expected, as no efficient method was used. Men were employed using old currycombs and wire brushes. A total of 5,060 sq. yds. of brick were removed and because of narrowing the street only 3,545 sq. yds. were relaid. The excess yardage will be laid on another street. We did not credit this paving with the salvage of old brick.

The asphalt filler used had a penetration of 40 to 50.

Old stone curbing was reset and new stone radius curbs were set. All new radius curb set had not less than 10 ft. radius as compared with 2 ft. radius in the old curb.

It was necessary to do a little sewer work, such as making connections to the new catch basins and lowering some house connections. Cost of this is found in the expense statement.

Fig. 3 shows the pavement as com-

TABLE I—COST OF RELAYING OLD PAVING BRICK AT LYNCHBURG, VA.

	Material Used	Cost	Unit Price
Removing Old Brick	5,060 sq. yds. (1,050 cu. yds.)	$320.34	.0633
Excavation	Paving Excavation	1,518.90	1.448
	Park Grading	744.60	
Concrete Base	3,545 sq. yds. (394 cu. yds.)	3,681.24	9.353
Cost of Relaying Brick	3,545 sq. yds.	1,229.00	.347
Cleaning Old Brick	5,060 sq. yds.	756.72	.149
Resetting Old Stone Curb	2,177 lin. ft.	512.03	.235
Asphalt Filler	3,545 sq. yds.	711.79	.2008
New Curb Radius	336 lin. ft.	354.30	1.053
		$9,828.92	1.053
Engineering and Inspection		246.13	
General Expense (Includes Equipment; etc)		461.01	
Catch Basins and Sewers		171.76	
		$10,707.82	
Actual cost per sq. yd.		$3.02	

pleted. The new sidewalks are not included in the paving cost as this work in our city is handled under a separate petition. The cost of grading the parkways between the curb and sidewalk is given in our total cost. This item also includes the cost of seeding.

This is a residential street. Traffic should not increase greatly over what it is at present. If this proves to be the case, this street should give good service for the next 30 to 50 years, and that, too, with but very little maintenance.

In Table I is given the actual cost of the work.

FIG. 3—STREET COMPLETED BY APPLICATION OF ASPHALT FILLER.

TRAFFIC MARKING PAINT

Two tests of the Traffic Marking white paint manufactured by E. I. du Pont de Nemours & Co., have just been completed. One of the tests was made by the Pennsylvania State Highway Department, where the white traffic paint was laid on two separate locations—one on the brick road leading from Harrisburg to Carlisle at the western approach of the Susquehanna River Bridge and the other on Route No. 1, just above Rockville. The test proved that it kept its color on oil surface roads in better fashion than any paint hitherto used. Another test was made by the Massachusetts State Highway Commission, and a favorable report was made by that body also on the durability of the paint. There is a constant demand for white traffic paint from municipalities and highway bodies for the purpose of marking out zones along streets and highways. This demand has become so large that there is at least one firm specializing in this kind of paint.

FINANCING A STATE HIGHWAY SYSTEM

By Roy D. Chapin, President Hudson Motor Car Co., Detroit, Mich.

We can be assured that the premises upon which we are laying the foundation for vast highway systems are intrinsically sound. This need is not a temporary one and we are justified in large expenditures so long as we can be assured that the policies which we lay down for the control of those expenditures are wisely shaped.

The task which confronts us, then, is one that requires the wisdom of the statesman, the vision of the social economist, the acumen of the financier and the efficiency of the engineer.

At the outset it places a heavy burden upon all responsible authorities, with a sure compensation ahead for those who proceed with the needs of all in mind, and with just as sure a reaction against those who give heed to special as opposed to the general welfare.

Manufacturing Problem Presented

In any analysis which I have made of the subject of highway finance, I have been impressed with the fact that what we are concerning ourselves with is fundamentally a business proposal. After all we are not dealing merely with the building of roads. We are dealing instead with the production of transportation, which is just as much of a manufacturing process as is the building of the motor vehicle itself.

Accordingly, the business analogy presents itself as a sound rule for highway policies, since in its adoption we return to principles which have been tested and found practical over a long period of years.

The first item then is to analyze the need. This we have done. Next we must determine just what roads are essential to earn the income which shall justify our expenditure, how rapidly these roads shall be built, which ones shall take precedence.

Analysis of Financial Resources

Knowing these factors which can be surely determined by careful and accurate surveys, not alone of traffic but of economic possibilities, we must then proceed to analyze our financial resources, determine our possible income and then proceed to select that type of administration which will build our highways most carefully and most economically, with due regard for the purposes for which they are intended.

Policies Will Vary

The first question, then, which confronts us is a determination of the present stage of development of this manufacturing plant which we are taking over. If it is a going concern, with ample facilities in the shape of already improved highways, then we will probably find that we can draw sufficient revenue to meet our requirements from current operating income. We may need a short term bond issue here or there, to take care of a special extension such as a widened road or improvement from an inferior to a superior type of pavement, but in the main we can pay-as-we-go.

Of all of the states in the Union, Maryland is perhaps the best example of this kind which we have and one of the very few, since Maryland has already improved most of its main system through long term bonds and is now concerned chiefly with the maintenance of these highways to meet the traffic requirements.

If we are discussing a state such as Michigan, however, we find a somewhat different situation, A fifty million dollar state bond issue, coupled with county and federal funds, will complete all of the state system except the 400 miles added by the last legislature. That completion, however, does not include improvements of a number of gravel roads which must be raised to a higher type because of increased business or traffic and, consequently, the situation may present the need for new manufacturing facilities or roads which may require a supplementary bond issue, the extent of which will depend upon the actual growth of traffic in the interim.

Virginia Example of New Territory

Then we turn to a state such as Virginia, only now upon the threshold of a venture in the production of transportation. Here the plant is in such shape that if we hope to care for the business which is awaiting us now, we must immediately turn to a bond issue as the means of raising the initial capital outlay, as otherwise the drain on our current income would be so great that while we might be able to construct our roads, we could not maintain them. And it is just as absurd to build roads and not maintain them as it would be to build a factory and then allow it to go to pieces.

Beyond that, however, we have accepted theories in business finance which apply definitely to the case at hand. No large

business organization today, or few small ones, will attempt to finance capital expenditure out of current income. The reasons are obvious. If, for example, a manufacturer should say "I need a new factory. It will cost me $50,000 and will produce 10,000 tires." He could not then say, "I will distribute that cost $5.00 per tire over my next year's output." Business competition would not permit such practice, but he could distribute that cost over a period equivalent to the length of life of the factory, and then assess each consumer accordingly.

What Is the Life of Highway?

The question which then arises is, "what is the life of this factory?" You will hear men say that our roads are going to pieces and that the analogy between business and engineering practice breaks down at this point.

If this question arose in a business plant, the executive would call in his research men and put the question to them. Suppose we call upon the research men of the U. S. Bureau of Public Roads, or, taking a short cut, turn directly to the report of the chief of the bureau, T. H. MacDonald?

"Much that we have known about highways is not so" we read, and summarizing an official viewpoint, we find that a close survey made by the Bureau shows that 40 per cent of all of the Federal Aid projects costs has gone into permanent features of the highway such as location, drainage, gradients, curvatures, shoulders and engineering costs. Of the remaining 60 percent, allotted to surface costs, we find that when the time for reconstruction of the highway comes all but a percentage equivalent to the cost of interest and sinking fund is salvaged as bedding for the new surface.

In a word, we find that we have been led into the fallacious belief that to lose the surface has been to lose all.

Lack of Maintenance Funds Costly

But this is not all. The executive searchings for still further supporting data finds that in many cases the actual reason for surface deterioration has been a lack of adequate maintenance, an overloading of equipment in times of seasonal strain. Expert opinion tells him that the engineer can build the road to handle the traffic and that all that is required is absolute maintenance.

The judgment then is that we are justified in distributing our capital costs, provided we require maintenance, and we can proceed knowing that what we are doing is to provide as expeditiously as possible a network of highways which we shall have the use of in our lifetime and which we shall pass on to our children for their use, in turn, each generation paying a fair rental charge in the form or maintenance costs plus amortization costs.

Will it cost us more to follow this plan than to pay the charge from current operating expense? Yes. Are we justified? Yes. how? By these two facts, either of which is sufficient. First, we are supplying a universal human need—adequate transportation for all. Second, the increased use of the highways by the public in our own lifetime will more than offset the amortization charges, even if we could deny the increased valuations which will accrue to urban and rural properties, which we cannot. Moreover, if we built from current funds, we should have an average of only 50 per cent of the use of a given mileage in, say, a 10-year program, while by paying as we use, we shall have practically a 100 per cent usage. Yet the difference in cost is only found in the amortization charge.

Rigorous Limitations Necessary

We shall not make these statements, however, without imposing certain rigorous limitations. One, that of maintenance funds, has been mentioned and it cannot be stressed too emphatically.

Further, state bond issues should not be sought for roads of purely local use. Generally speaking, these will carry only a light traffic and maintenance costs will suffice. State issues should be concentrated on those highways which traffic and economic surveys show are of first importance from the state point of view. If this system is carefully laid out, it will be found that there are few points more than 15 miles from a main road and the policy of financing these feeders will depend upon the character and extent of the traffic.

Again, the administration is an important element. The leaders must be men of vision who will deal with this problem as with any major issue of public welfare. Control should be centralized in their hands as the local man cannot be expected to, nor should he, consider state needs first. Any departure from such a program as this is likely to result in disconnected highways and the question of maintenance becomes a highly uncertain equation.

Traffic Regulation Paramount Issue

The question of traffic regulation is an-

other where only the state official can act with due regard for the economic needs of the community. We have indicated that overloading of the plant has been a partial cause for its breakdown in the past. Power should be lodged with the state authority so that he can prohibit overloading the vehicle in normal times and can make such restrictions as to loads as will safeguard the general welfare at seasonal periods.

By the same act, the commissioner should have power to permit overloading in emergency. The only purpose for road construction is to serve traffic and situations such as the present railroad congestion may make it cheaper at times to break down an inadequate highway surface than to permit unemployment, hunger or cold to come to a community.

This brings us logically to a discussion of what kinds of highways we shall construct. The answer is found solely in economics. That type of highway should be constructed which will care not only for the present but for the future needs of traffic. No highway improvement is justified if it does not satisfy a human need or unless the cost of improvement is more than cared for in the saving effected to the public through better and cheaper service. The problem is so large, the needs so many and diversified, that over-development is just as serious an economic error as undevelopment.

Construction and Maintenance Defined

How are we going to pay for this improvement? In a general way we have said that original construction is a matter of capital outlay; so also is any extension or any replacement of an inferior type of pavement to the extent of the difference in cost. The analogy is that of a new factory building or the replacement of old machinery by improved units.

Maintenance then becomes all of the remaining charges or in effect the constant making of needed repairs up to and including reconstruction, in order that the plant may give service at all times.

At this point we are faced squarely by the need for saying from what sources we are to draw our income in order that our finances shall be equitably levied so that the public may buy its transportation at the lowest possible cost.

Answer Varies With Locality

The answer will vary in detail according to the stage of development of the system or plant with which we are dealing. It will vary according to population, square miles of area, mileage of roads under consideration. But still we have before us definite principles based upon studies of fact which well may be taken as sign posts.

It is a safe principle to say that those who benefit from the highway shall pay for its construction and maintenance. Who is it that benefits? Definite economic surveys made by the Bureau of Public Roads show that in the initial improvement of the highway there is found an accretion in the value of land in the vicinity which ranges anywhere from 300 to 1,000 per cent. More important, there is the fulfillment of a human need which, while it may not be directly susceptible to economic treatment, is none the less a large factor in road construction, particularly in the agricultural regions.

Urban Valuations Increased

Urban valuations are also increased by the construction of rural highways, because not only does the highway bring new buying power to the city but it also brings about a tremendous suburban development which is, as yet, only in its infancy.

Finally, the man who uses the highway finds his costs lessened as it is improved, or better, as it is maintained in a constant condition of service.

Taken in sum, these three elements represent all of the tax-paying elements of the community; hence it may be fairly said that capital charges for highway construction should be provided for from general taxation whether these payments are made in the form of amortization charges for a long term bond issue, which spreads the charge over this and succeeding generations of beneficiaries, or whether it be a special levy.

When we come to the question of maintenance, however, the problem is not as clear, as we have not had sufficient research to determine accurately all of the secondary influences of improvements upon valuations.

We do know, however, that the user of the highway is one who obtains the first service from it, that his costs are affected as the highway is kept in condition or allowed to go to pieces, and finally, that much of its depreciation is due to use.

Provides Annual Revenue

It thus appears that the user should be charged with the upkeep of the road, a principle which is sound from a financial standpoint in that our present system of motor registration is a recurrent annual charge which automatically produces the revenue necessary to maintenance. For

this reason, it is fair to insist that motor fees should be set aside for maintenance rather than diverted into construction, and further, it is reasonable to demand that the administration of these funds shall be so controlled as to make the highway of the utmost service.

In conclusion, then, I should say that we cannot solve the highway finances of a country so diversified as this by any detailed formula, but we can proceed to adopt certain definite principles which mty be expressed somewhat in this way.

Principles Suggested for Adoption

1. Highway systems should be laid out by state highway departments, with a definite view to meet the social and economic needs of the commonwealth.

2. The funds needed for original construction should be secured from long term bond issues and the money needed to amortize these bonds should be provided for from general taxation. The funds needed for maintenance should be secured from current operating income derived from the user and should be adequate to maintain the highway once constructed.

3. Centralized administrative control is essential to a proper development of these systems as well as to the regulation of their use, and broad powers should be granted the state department in charge, to insure an economic flow of traffic.

It is hardly necessary to emphasize, in closing that the need for general bond issues will be dependent upon the degree of present improvement of the system.

The problem which confronts us is one of satisfying a proven human need, the elemental desire for individual transportation, the fulfillment of which is a social as well as an economic necessity to our further progress.

The more rapidly our finances can be placed upon such a basis as this the more rapidly will the states, as a whole, afford new opportunity for free communication which should be the right of all.

The foregoing is from an address by Mr. Chapin before the recent annual meeting of the Michigan State Good Roads Association at Grand Rapids.

FEDERAL COURT UPHOLDS VALIDITY OF WARREN PAVEMENT PATENT

Immense costs of litigation plus hundreds of thousands of dollars in royalties —in all a bill which may exceed $300,000 —is what will have to be stood by the state highway fund of Oregon as a result of years of demagogic agitation against paying anything for the right to use patented paving, says the Oregon Voter for Oct. 7, 1922. The article continues as follows:

In Oregon we have a State Highway Commission which in quality of personnel is of the highest rank, the foremost men of the state in personal integrity and demonstrated business success are and have been the members—and this highway commission contracted for miles and miles of patented paving, giving it the preference at an equal price in competition with unpatented pavements of supposedly equal quality. The agitation was carried to the point of attempting to destroy the character of individual commissioners. There seemed to be no limit to the hysteria of defamation.

Year after year the legislature refused, by ever-decreasing majorities, to enact legislation against patent paving. But as men of courage were retired on this issue, and demagogues elected to replace them, it was only a matter of time before the majority would be the other way. This came about three years ago, shortly before the paving patent expired, and legislation was enacted directing the attorney general and the state highway commission to use the type of paving regardless of the patent and fight the patent in court in order to avoid payment of royalty. With this legislative direction, there was nothing for the highway commission to do if it desired to use this superior type of paving but to use it and fight the patent.

In this way the issue was brought into the federal court.

In defiance of this patent right, the state contracted for about 1,200,000 yards of the patented type of paving, and entered into contract with the contractors to protect them from infringement suit. This was according to the legislature's intsruction.

Prior to that time, millions of yards of this same type of patented paving had been contracted for by the highway commission on a competitive basis—type against type, with price considered in proportion to quality. The matter of royalty did not enter into the award—that was fixed after open bidding on a competitive basis. It was a matter of common knowledge that the competition was so keen that the amount of royalty fig-

ured in the price was only 10 cents a yard.

But with defiance of the patent and use of it regardless of its proven standing in court, the patentee was in a position to sue for his full royalty of 25 cents a square yard—which on 1,200,000 square yards amounts to $300,000. The test suit was brought against one contractor only, and covered only 75,000 yards. Judgment for the full 25 cents a yard was awarded by the federal district court, the opinion being handed down by Federal Judge Robert S. Bean.

This opinion shows that the opposition to the patent through all these years had not a leg to stand on. Everybody who had studied the facts knew that this was the case, but the agitation was kept up regardless of the facts. No decision could be more sweeping in its denial that there was any real justification for having brought the case into court at all.

This decision, except for the appeal with its inevitable result, is the end to an agitation which has torn the state for years,—except that the bill must be paid to the tune of several hundred thousands of dollars which otherwise might have been expended for much-needed road construction. It is an end that was inevitable from the start. At no time was there any real ground for the agitation, for the courts had sustained the patent time and again. The unfortunate thing about it, aside from the reputations wrecked by demagogic newspapers and the wasteful acts of incompetent officials, is that the final huge cost must be paid out of the highway fund instead of from the property of those who prospered by a wicked agitation.

The decision by Judge Bean is brief. Its full text follows:

Full Text of Opinion

"I have at great labor carefully examined the elaborate record and briefs in this case and am satisfied the plaintiff is entitled to the relief demanded.

"The patent in suit was issued in May, 1903. The pavement therein described has been extensively laid throughout the United States and proven a commercial success. The validity of the patent has been contested in practically every state in the Union and with few if any exceptions has been upheld. It was held valid by the Court of Appeals of the Sixth Circuit after a strenuous contest. Judge Lurton writing the opinion in Warren Brothers vs. City of Owosso (166 Fed. 309), the Court of Appeals of the Second Circuit in Warren Brothers vs. New York (187 Fed. 835), and by the District Courts of Alabama (Warren Brothers vs. Montgomery, 172 Fed. 414), Michigan (Warren Brothers vs. Grand Rapids, 21 Fed. 364), Pennsylvania (Warren Brothers vs. Evans, 234 Fed. 657), Ohio (Warren Brothers vs. Pace, 247 Fed. 117), and New York (Warren Brothers vs. New York, 187 Fed. 832). Injunctions have been issued in many courts restraining the infringement of the patent and in only two or three instances, so far as I am advised, been denied and then for reasons not affecting the merits.

"The patent was recognized as valid by the defendant and by the State Highway Commission, the real party in interest, and many miles of pavement laid under license from the patentee upon which royalty was paid prior to the legislative act of 1919, providing that if in the opinion of the Attorney General an alleged patent is invalid or of doubtful validity the State Highway Commission may, if it deems such patented material to be advantageous in the construction of a highway, use or contract for the use of same and indemnify and hold harmles any contractor as a result of such use. The question of the validity of the patent, in pursuance of this law, referred to the Attorney General who reported that without further litigation he could not advise whether it was valid or not. The Highway Commission therefore contracted with the defendant for the laying of certain pavement and stipulated that it would indemnify and save him harmless against the use of a patented article, and hence this suit.

"The decision of courts other than the Court of Appeals of this circuit are, of course, not binding on this court, but they are strongly persuasive and when, as here, there is such a mass of decisions uniformly upholding the validity of a patent, judicial comity suggests that a trial court should not assume to declare them erroneous or hold the patent invalid unless for some defenses not before considered, sustained by clear and satisfactory proof. As said by Judge Dickenson in the Evans case, supra, referring to the patent now in suit:

" 'Independently of the merits of the question of the validity of a patent, there must come a time when that question must be deemed to have been settled, whether rightly or wrongly, nevertheless settled. If this be not so, rights evidenced by letters patent are no rights at all. All which can profitably be said

upon the subject of the validity of this patent is embraced in the opinions accompanying rulings already made. * * * Such validity is supported by the prima facie findings of the patent office. It has confirmation in a juridicial experience so extensive that a mere list of the cases in which it has been litigated would unduly lengthen this opinion. This experience has embraced adjudications, not only in a number of the District Courts but in the Circiut Courts of Appeals in two different circuits and recognition in three other circuits supplemented by consideration in almost, if not quite a round dozen of applications for preliminary injunctions. Out of all of this judicial consideration, something in the nature of the establishment or denial of some definite rights must have resulted. What we find has resulted in the establishment of the validity of claims 5, 6, 9 and 11 of this patent beyond the reach of successful attack upon any grounds then litigated.'

"The defenses made in this case of anticipation by prior uses, prior patents and literature and double patenting are the same as those involved in prior litigation either in fact or in kind. The evidence here does not show anything substantially new in respect thereto, or any reasons why the conclusions of such courts should not be followed.

"The pavement of McGovern Alley in Denver, principally relied upon, and the Pittsburg pavement, were held by Judge Dickenson in the Evans case, supra, not to anticipate the Warrens' patent. Washington pavement, in all substantial respects the same as the one urged here, was rejected as anticipation in the Montgomery and New York cases. There is nothing, as far as I can see, in the evidence concerning South Omaha and Hamilton pavement to anticipate or invalidate the plaintiff's patent. The alleged prior patents and literature contain nothing new in kind from what was before the courts in the other litigation. The defense of double patenting is the same as was urged in the Owosso and New York cases. All these matters have been carefully considered by able courts, after protracted and painstaking litigation and nothing could profitably be added to the discussion.

"The defense of non-infringement is not made out. The pavements laid by the defendant under his contract with the State Highway Commission and involved in this suit are in all particulars the same as that previously laid by him and the Highway Commission upon which royalties were paid and in my opinion are clearly infringements of plantiffs' patent.

"There is no dispute as to the yardage, 74,541.8 yards, and the evidence shows beyond question that 25 cents a yard is a reasonable royalty.

"Decree may be prepared accordingly."

LIGHTS FOR MOTOR AND HORSE DRAWN VEHICLES AND HIGHWAYS

By David Beecroft, Directing Editor, The Class Journal Co., 239 W. 39th St., New York, N. Y.

Highway accidents always serve as a spur to new regulations and laws governing the operation of motor vehicles, and whenever accidents increase there is generally an increased activity among the drafters of bills in the field of motor legislation.

Unfortunately there has not been as broad a study of the causes of accidents, or even the classification of accidents in the different states, as there should have been, and those drafting new bills are generally without that knowledge of the cause of accidents which should serve as a good guide in drafting remedies that will function effectively. Too frequently measures have been passed to avoid accidents which have been drafted without any knowledge of the causes of accidents which give rise to the legislation, with the result that the new laws have not been the answer to the question.

We are having accidents with motor cars, motor trucks, pedestrians, motorcyclists, horse vehicles, and, in short, all classes of vehicles. There is no general agreement among state officials as to the cause of these accidents.

In Michigan, Chas. J. DeLand, Secretary of State, says that accidents are occurring continually on the highways of the state due to improper equipment of both motor truck and passenger cars. Secretary DeLand goes on to state that no other law on the statute books of Michigan is more openly violated than that regulating lights on motor vehicles of all descriptions. The Hon. Secretary makes no reference to lights on horse drawn vehicles, or the absence of them. That is a factor in the category of accidents. However, he continues: "Trucks are being operated on the highways with a searchlight on the cab which is like a blinding headlight to persons approaching in the opposite direction and these

same trucks very often have a big trailer with no light of any description on the rear, to say nothing of the width of the body. My suggestion is some drastic legislation that will compel owners and drivers of trucks to equip same with two white lights on front that can be turned on the road and with a red or green light on each side of the truck on the rear." So much for the views from Michigan.

New York state has a different report. Bert Lord, the Director of Motor Vehicle Bureau of the state of New York says:

"I have no information on file as to accidents. However, I am aware that there have been a number of accidents due to wide truck bodies and on account of it a bill was introduced requiring a green light on the outer left-hand corner of the truck so that motorists could know the width of the truck body when approaching. The measure did not become a law and I do not think I would approve the green light. However, a white light possibly would be good."

I am glad to see Mr. Lord opposed to green lights for reasons to be given later.

The state of Maryland has a system of highways used a great deal by motor trucks, but D. Marshall Shroeder, Deputy Commissioner of Motor Vehicles, cannot recall any accidents due to the width of motor trucks. His office does not classify accidents or collisions between different types of motor vehicles.

Mr. Shroeder continues: "I do believe that it is an excellent plan to suggest that all motor vehicles carry a light similar to a parking light on the extreme left, showing white in front and red to the rear."

The State Commissioner of Connecticut has gone further than officias in any other state in a study of accidents and for two years has investigated every accident occurring on the highways of the state and has classified these accidents, showing the number in which the blame is due to motor cars, motor trucks, motorcycles, trolley cars, horse vehicles, railroads, pedestrians, etc. This analysis for 1921 shows that approximately 91 per cent of all accidents on the highways can be eliminated by highway improvements, better highway lighting, improved signals, better lighting of motor vehicles, improved regulation of all vehicles and general education of those using the highway. The Commissioner of Motor Vehicles believes that only 7 per cent of all highway accidents cannot be avoided. Because of the study that has been given to this subject in Connecticut, we should hear carefully what the Commissioner of Motor Vehicles has to say. He exhibits that commendable qualification of meekness, admitting that the more he has studied the subject, the less is he willing to attempt to settle the entire question by regulating lights on different classes of vehicles:

"I need to be convinced that accidents happen on account of the absence of some light which will indicate the character of the vehicle and while I have not our statistics on this point yet,—offhand, I am doubtful as to whether they will bear out the suggestion that has been made to the effect that lack of lights indicating truck width is a fruitful cause of accidents. These words from Robbins D. Stoeckel, Commissioner of Motor Vehicles for the state of Connecticut, are deserving of careful consideration, as this state is crossed by the highways between New York City and Boston; in fact, by the highways between New York City and the greater part of New England. These highways have heavy motor truck traffic; perhaps heavier than any other state in the Union.

In the commonwealth of Massachusetts the green light on the extreme left side of the truck is favored. It is considered a convenience as well as a factor of safety.

Pennsylvania has no record of any special accidents caused by motorists not being familiar with the widths of motor trucks.

Minnesota has had very few accidents due to the width of trucks and has no regulations calling for lights to indicate truck width, but Secretary of State Mike Holm adds:

"We have had very few accidents due to truck width." Time will not permit further comment on the experience of the different states but in no others can evidence be secured that width of truck has been a special factor in accidents.

After reading the opinions of motor vehicle commissioners in half a dozen states that now have heavy motor truck travel, only one conclusion can be reached, viz: that perhaps with the single exception of Connecticut, no adequate analysis of accidents has been made to establish any relationship between lighting of vehicles and the accidents.

Perhaps up to the present we represent the concensus of opinion by stating that motor cars are too often overlighted and motor trucks generally underlighted. We

rarely meet the motor truck with its dazzling headlight, but too frequently we meet the inefficient pair of oil lights on the truck that are not adequate and are in reality useless except as signal lights.

Let us now briefly consider the highways on which these vehicles operate day and night. Some of these roadways have become virtually high roads for commodity and passenger transport, similar to our railroad lines. They have outgrown quite entirely the use made of them a few years ago, yet notwithstanding this transition, they are not lighted in any sense commensurate with the travel on them. Perhaps the road surface has been improved, but more equipment is needed along these high roads of commerce than merely a surface.

Why should we not take a chapter from railroad transportation, trolley transportation and marine transportation and equip these highways as the traffic over them demands? In other words, after building a permanent surface roadway, complete the job by getting it ready for use, not merely in daylight hours, but during as many hours of the night as the need of the times demands. Again, may we repeat: Let us finish the job.

A railroad is not completed when the roadbed is done and the steel rails laid. The signals for day and night travel are as essential as the steel rails. Our riverways and canals are not completed when the adequate depth of channel is achieved; the signals for day and lights for night must be installed. What an intricate signal system has been developed along our coast for coastwise and high sea travel! What a system of lights and signals has had to be established for the air service between London and Paris, as well as other air routes!

In this rather extended reference to railroad, marine and aerial lighting along their respective ways of travel, there has been no thought of diverting attention for adequate lights on all users of our roads, but rather the thought has been to survey broadly all factors entering into safety on our highways and not to be guilty of approaching the subject from a single and selfish viewpoint.

Elimination of accidents will not be achieved by attacking at one point but rather by correlated attacks at all points where attention is needed. Connecticut has shown that where an accident a day occurred on a part of the nighway, further accidents were practically eliminated by relocating a short portion of the highway and removing bordering interferences. The old location was safe for horse traffic and for years was fairly safe for motor traffic, but with the present multiplication of traffic, the only solution of accidents lay in relocating the offending section of the highway.

Our cities have done excellent work by improved traffic control, by establishing safety zones for pedestrians, by an attempted control of pedestrians, by surface markings on streets, by suitable night signals, etc. This commendable work prompts us to ask the question if our State Departments, having control of our highways, have realized sufficiently that some of this work needed in making our cities and towns safe, should be extended to the rural highways, particularly those portions constituting main arteries with heavy travel all day and part of the night.

Highway Lighting

Before leaving this aspect of the highway, let us consider briefly the subject of highway lighting. It is only in the last few years that this subject has been given anything resembling serious consideration by concerns that have developed systems for city lighting. The A B C of highway lighting has yet to be written. A few stretches of highway are being lighted with experimental systems that give promise of excellent results and our state departments must keep this subject in mind as a part of the problem of making our highways safe and a part of the task of highway regulation.

The last year has witnessed rapid development in the use of signal lights at street interesections in suburban areas. No uniformity exists in the color or location of these lights. In one city of 40,000 population in the zone of Greater New York are three different colored lights on a leading highway in the distance of two miles. All three are blinking types of intermittent lights, one showing a green light in both directions; another green in one direction and white in another; and another red in one direction and green in another. There is no field for intermittent lights of this character on the highway because of the tax they impose on the mental energy of the driver. A steady green light is preferable and safer. In a night trip of 20 miles north from New York City and in other directions as well, the driver is confronted with a veritable chaos of lighting schemes, each of which demands a mental problem at a time when the driver is

approaching a danger zone and when most of his mental alertness is needed in watching other users of the highway and controlling his vehicle. All highway signal lights of this character should be standardized not only as to color, but as to height and location.

Lights on Vehicle

Coming to the consideration of the lights to be carried by all vehicles using the highway, I aim to be sanely conservative by emphasizing that the time has arrived when vehicles of all character must be equipped with a lighting system, standardized so far as color and position of lights are concerned. We cannot temporize longer with the horse vehicle without lights—that is a double danger—first to itself and second to the other users of the highway. We cannot temporize further with the motor truck that hangs a lantern with a red glass from the center of the body at the rear. We cannot temporize further with the traction engine pulling a threshing machine and water wagon with not a rear signal light and too frequently a single lantern with white glass on the front.

Our highways at night are no longer used for a few miles by residents along the route, but nightly are interstate roadways used by vehicles whose owners may reside in the adjoining state or several states beyond. Nightly these highways are used by those who are often strangers to them, not infrequently by many who may not use them again for years. This character of travel makes it correspondingly more important that all users observe the lighting laws. In writing regulations governing lights, there must be no favoritism for any particular type of vehicle, all must be considered as users of the highway and equally subject to regulations governing their use.

Considering the specific lights used perhaps no one light has been more widely discussed during the past year than that of the color of the tail light. About one year ago a movement was started, backed partly by railroad interests, to have the use of the red tail light on motor vehicles discontinued and a yellow light substituted. The reasons advanced were that where roadways paralleled railroad lines, locomotive engineers were at times confused in their signals. Fortunately, we feel certain there has been a change of heart and now the railroads are resigned to the use of the red tail light on motor vehicles and everybody else from scientists down, are of the opinion that there exists no better rear signal than the red light. Its future use is undoubtedly assured. It should be the universal light for the rear of all highway vehicles, motor propelled, horse-drawn or propelled by persons. Such a standardization of its use will simplify night driving, will conserve the mental energy of the operators of all types of vehicles and should be conducive to better physical control of vehicles, with a corresponding lowering of accidents.

Granting that the red tail light is to be the permanent light, its location is yet open to debate and also the candlepower of the light adequately to illumine the state registration numerals. The commonwealth of Massachusetts has recently attacked this problem with vigor and the new law requires the lamp portion to be above the middle of the license bracket and to throw a white light over the face of the numerals. This light must be thrown through a glass portion of the lamp and not through mica or celluloid window. No objection can be urged against what Massachusetts has done. It is merely carrying out the intent of the original law in many states covering the illumination of lighting bracket. This new law is a just one.

The location of the tail light is far from being a settled question, particularly on motor trucks, threshing machines, trailers, etc.; the extreme left rear of the body is considered generally the most useful location in that it designates the extreme edge of the body and so serves as a guide to overtaking vehicles that must pass on the left. This location should avoid those accidents due to no indication of the body width when the light is under the center of the chassis. A red light at the extreme left should be carried on all types of horse vehicles, motor vehicles, trailers and machinery in tow, such as threshing machines, etc.

There is no necessity for two red lights on the rear of any vehicle. It has been suggested that on large trucks there should be a light at each side of the body at the rear. Some states go so far as to suggest a red light at one side and a green light at the other. Two lights merely double the number the drivers in following vehicles have to see. They will confuse rather than clarify.

Our lighting of vehicles and roadways must be simplified to the final syllable and it is the first rule of vehicular lighting not to use two lights where the job can be done better with one. This may

be opposed to the business adage of making two blades of grass grow where one grew formerly, but the case is different. Let the rule be to let one suffice if it does the job. Further, there should be no necessity for specially large tail lights on motor trucks, a standard size will suffice, if properly located, and with an adequate candlepower of illumination.

Still another thought with regard to the tail light. If it is to be placed on the extreme left rear of the body, it can play the dual role of showing a red light to the rear and a white light ahead, thus indicating the approaching vehicle, the extreme width of the vehicle body.

This brings us to the question of the use of a light showing forward that will indicate to approaching vehicles that the vehicle is a motor truck as well as indicating the extreme left side of the vehicle. You will recall that the use of such a light is much disputed by the motor vehicle commissioners in different states. The author of this paper is open-minded as to the use of such a light, but has definite opinions concerning its color. Only a white light should be used. A green light has been suggested, but it will add to the confusion of drivers of approaching vehicles, particularly at the present time when green lights are used on highways for so many other purposes. We repeat: "Good lighting on vehicles should be simplified rather than be made more intricate."

The alphabet of color is red for danger stop.

White stands for forward illumination and signals. These are enough for the vehicle.

The universal alphabet of green is for caution and its use should be confined to the role of highway signals. The green light might be used to advantage to indicate highway obstructions, detours, roadway forks, islands or zones of safety, dangerous highway intersections and other highway markings.

The foregoing paper was presented at the recent joint meeting at Grand Rapids, Mich., of the National Highway Traffic Association and the Michigan State Good Roads Association.

HOW LONG SHOULD WATER WORKS BONDS RUN?

The proper term for which water works bonds should run was the subject of a paper recently presented before the New England Water Works Association by Charles W. Sherman of Metcalf & Eddy, Consulting Engineers, 14 Beacon St., Boston, Mass. The paper will doubtless be published in full in the Journal of the Association. Mr. Sherman's conclusions are as follows:

1. The average life for a "typical" water works plant in this country is about 50 years. It will rarely be less than this in individual cases, and may be as much as 60 years or more for some works.

2. Complete records of depreciation, including abandoned structures, of a number of water works plants of considerable age show that the total accrued depreciation of the physical plant of such works is about 20 per cent of the cost. Departures from this mean are not great. Records of depreciation suffered by the plant still in service, modified by a suitable allowance for plant abandoned, confirm this as a reasonable normal figure.

3. The corresponding average age for works of 50 years' life is 20 years, leaving 30 years average remaining life. If the average useful life were 60 years instead of 50, the average age would be 27 years and the remaining life 33 years. Thirty years is a fair estimate of the average remaining life of any water works plant in normal condition, and therefore a proper term for which water works bonds should run.

4. If the works have suffered a depreciation of 20%, including abandoned property, there is a residual value of 80% of cost of the physical plant. Water works bonds may therefore safely be issued up to 80% of the normal cost of the works.

5. Municipally owned water works should be self-supporting and their financing should be on the same general basis as that of private corporations.

6. The clause of the present Massachusetts law which limits bonds for the extension of municipally owned water works to a term of 5 years is illogical and burdensome, and should be repealed.

7. Special legislation for particular cases, made necessary by the existence of the 5-year limit, is undesirable from every point of view.

8. Suitable control over municipal bonds for water works purposes can be exercised by requiring the approval of the Public Utilities Commissioners in exactly the same way as for bonds of a private water company.

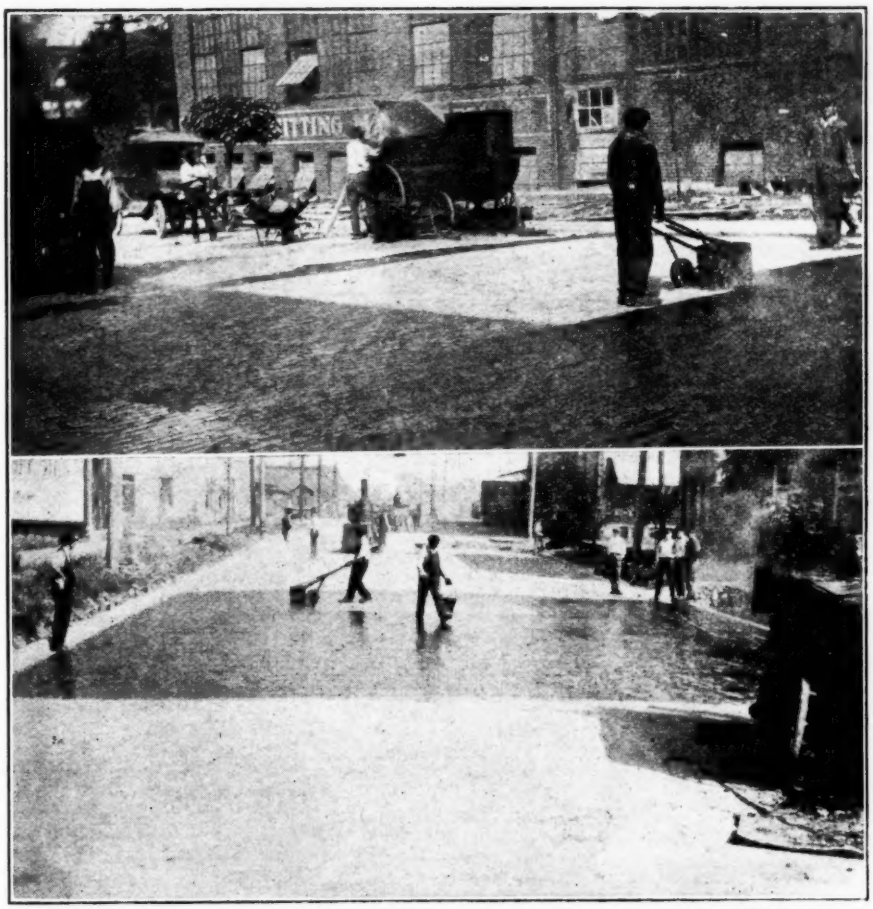
9. Misuse of water revenues can be avoided by legislation limiting their uses to water works purposes.

EFFICIENCY IN THE APPLICATION OF ASPHALT FILLER

By J. F. Gallagher, Asphalt Sales Department, The Texas Co., 10 South La Salle St., Chicago, Ill.

Contrary to an all too common opinion, the proper application of asphalt filler to brick pavements is somewhat of an art, as definite and distinct as the mixing of concrete for the foundation, or the placing of the brick themselves. The main thought in the minds of many individuals as regards the application of the filler is to cover the greatest yardage in the shortest possible time. They almost lose sight of the fact that the function of the filler, as its name implies, is to fill the interstices between the bricks and to leave a relatively thin carpet coat on the surface. A moment's thought will bring out the principal factors incident to this end, and while some of the features mentioned below may seem to be so obvious and elementary to some as to render them unworthy of space in these columns, experience and observation seem to indicate that it is these simple considerations which are frequently overlooked in practice.

For instance, we frequently see the unfilled brick being rolled and re-rolled on the fresh sand cushion, with the result that an appreciable amount of sand is forced upward into the spaces between the bricks. In many cases the sand will more than half fill the joints, so that it is physically impossible thoroughly to fill them with asphalt. As is generally recommended by those whose experience qualifies them to speak with authority, before any asphalt is poured the brick

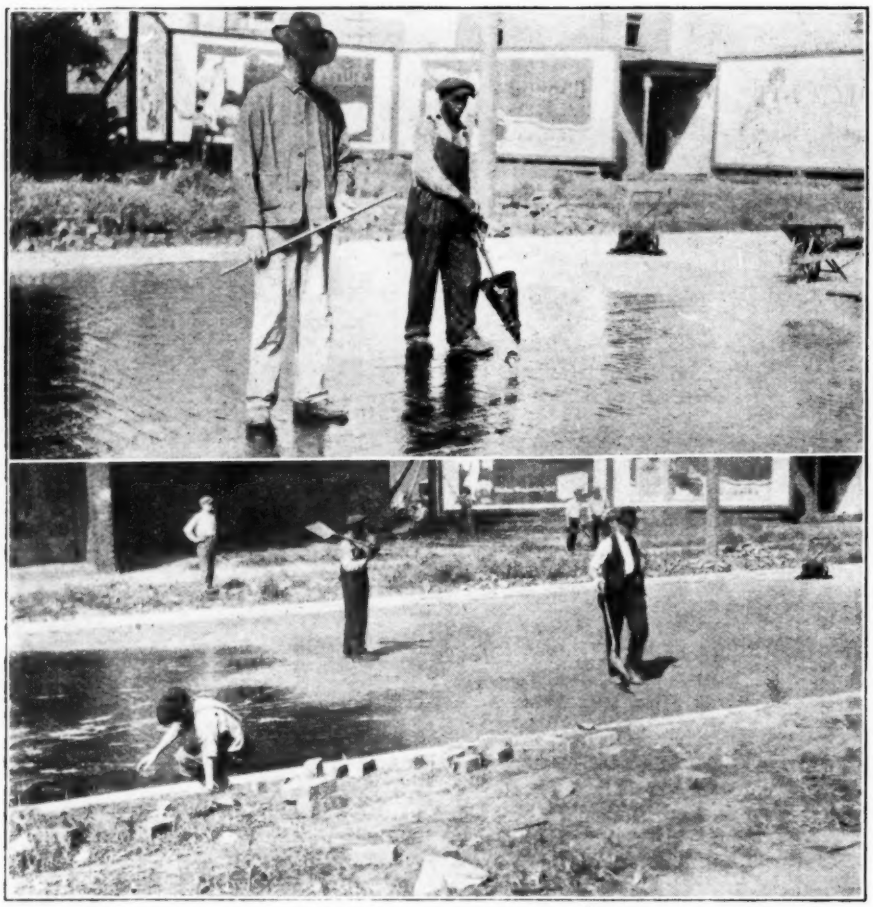


APPLYING ASPHALT FILLER ON BRICK PAVEMENT AT DECATUR, ILL.

Upper: First Application of Texaco No. 39 Paving Filler by Squeegee Cart Method. Lower: Another View of the Application of the Filler by the Cart Method. Completed Pavement in Foreground.

should be swept carefully to remove any sand or foreign matter which might affect the bond between the asphalt and the brick surface, as even a thin film of sand or dust will seriously hinder the adhesion of the hot asphalt to the brick. Also, in order to effect thorough adhesion, the brick should be dry, as any dampness will result in a foaming of the hot asphalt when it comes in contact with the moisture, due to the latter being converted into steam. In this way the asphalt is chilled before it has had an opportunity to bond with the brick and probably will be quickly worn away by traffic.

Another feature frequently given too little consideration is the preparation of the asphalt for applying. It is most desirable to cut the material into chunks as small as practicable. This will materially shorten the time required to bring the contents of the melting kettle to the desired fluidity, due to the greater surface area exposed to the heat. It is infinitely better to spend a little more time in cutting the asphalt into small pieces than to put a few large chunks into a kettle and try to rush the melting of it by increasing the intensity of the fire beneath it. Too much stress cannot be placed on the fact that the most approved method of melting is by a slow uniform heat and frequent stirring. Incidentally, there are many cases where no means of stirring is provided on the job. An old mortar hoe can be used for this purpose conveniently. However, regardless of the instrument, the molten asphalt should be stirred regularly to prevent charring, and as the material most liable to be affected is that in the bottom of the



APPLYING ASPHALT FILLER ON BRICK PAVEMENT AT DECATUR, ILL.
Upper: "Pointing Up" After Final Application of Texaco No. 39 Paving Filler. Note Uniform Surface. Lower: Applying Covering Material.

kettle directly over the fire box some means should be provided for keeping it in motion.

The maximum safe working temperture for material such as is generally regarded as standard for brick pavements is about 375 deg. F. If the heat exceeds this point constant and thorough agitation must be introduced to avoid breaking down the adhesive qualities of the filler. For general purposes a satisfactory working range is from 300 to 350 deg. F. depending upon weather conditions and the characteristics of the particular material. In order to control the temperature it is strongly recommended that melting kettles be provided with satisfactory thermometers which may be suspended in the asphalt at all times during heating. There are several types of extra large armored thermometers on the market especially adapted for this purpose and of such design that the reading can be made

CHARGING MELTING KETTLE WITH CHUNKS OF TEXACO NO. 39 PAVING FILLER.

from a considerable distance from the kettle. They are so constructed that they can be suspended in the material and be temporarily removed while the kettle is being charged.

Practice of An Illinois Contractor

In the face of such widespread disregard of the fundamental principles leading to most satisfactory results from the use of asphalt fillers, it is indeed refreshing to witness the results obtained by an Illinois contractor specializing in work of this kind. Walter C. Schwartz with headquarters at Bloomington, Ill., has had a very broad experience in the construction of asphalt-filled brick pavements and has met with excellent results from a careful handling and application of the filler.

Having taken care of the preliminary features, such as sweeping the brick, etc., Mr. Schwartz makes the initial application of asphalt over an area of about 200 sq. yards. This partly fills the joints and leaves a thin film on the surface of the brick. After the asphalt has been given an opportunity to cool, it contracts so that the joints are only about half filled. Then follows a second application over the same area, which is intended to fill the joints flush and slightly increase the thickness of the surface coating on the brick. As applied the asphalt is flush but upon cooling it contracts and drops slightly below the general level. In order to bring this flush with the squeegee coat, a third application is made after which the pavement presents a smooth uniform appearance.

As will be found in almost any job of brick paving, there are usually a few brick the corners of which have been broken off in handling, or which may have been laid a little farther apart than the others. Of course such places require a greater amount of filler in order to eliminate the holes or relatively open joints. To take care of such spots, according to Mr. Schwartz' method, they are "pointed up" by means of the old fashioned cone-shaped pouring can.

After "pointing up" dry torpedo sand is spread in the usual way, and while hot sand is to be preferred, good results have been obtained in warm weather from the use of dry torpedo sand or stone chips free from dust.

One might gain the impression that the successful procedure as above outlined would entail the use of considerably more filler and a greater labor cost than the ordinary single-application method. However, Mr. Schwartz states that from his experience he has proved he does not use any more material than the average contractor in a single application. This he attributes to his squeegee machine method of applying the filler which enables him to go over the area much more rapidly than by the hand squeegee method. The second and third applications require very little material, and for the reason that the machine must of necessity be pulled over the pavement at a rapid rate in making these applications, the labor cost is low.

This method might be characterized as filling the joints "from the bottom up."

The accompanying views illustrate the

methods referred to as practiced by Mr. Schwartz on work at Decatur, Illinois, on which he was engaged as sub-contractor, the general contractors being File & Collins of Decatur. The asphalt used on this work was Texico No. 39 Paving Filler.

Attention might be drawn to the type of squeegee machine used, which is regarded by the contractor as being largely responsible for the success he has had in filling brick pavements. It enables the operator to apply as much or as little material as desired, the amount spread being regulated by the speed with which it is drawn over the pavement. Also due to the fact that the hot material is spread as soon as it strikes the pavement, a very uniform finish can be obtained. In this respect the writer considers it far superior to the ordinary hand squeegee, as it eliminates to a large degree the possibility of a large amount of hot material being poured over the pavement before it can be squeegeed into the joints. Where this occurs the material chills quickly, forming a relatively thick mat on the surface of the pavement, and instead of filling the joints, simply bridges them.

NEED FOR CONCERTED ACTION WITH RESPECT TO LAND DRAINAGE

By Edgar A. Rossiter, Consulting Civil Engineer, 127 N. Dearborn St., Chicago.

A number of events during the last decade emphasize the need of drastic and concerted action along the lines of National conservation and reclamation, flood control, reforestation, water power and drainage.

In the last ten years there have been a continuous series of floods on the various rivers of the country, leaving a trail of devastation in the destruction of shipping, docks, buildings, bridges and the flooding of cities and farm property, causing the loss of millions of dollars and, I dare say, that the total cost of this damage would have paid for the required flood control works.

The high price of an inferior grade of lumber and the total absence of the better grades brings to our minds the millions of acres of forest lands that have been cut with but little provision to replant these vast areas with new trees and the continuation of the policy will eliminate all the better grades of lumber and add to the cost of construction and living for generations to come, unless immediate steps are taken to reforest the cut-over lands that extend the entire length of our country.

The gradual increase in the cost of coal year after year and the mighty power displayed by the floods in our rivers should be a burning factor toward the development of water power wherever possible and the harnessing of these giants of destruction so that they may become the giants of constructive energy, thereby reserving the supply of coal.

Thousands of our best farmers are deserting and abandoning the worn-out soils of the Eastern and Central states, migrating to the fresher soils of Canada where the Canadian government has made wonderful inducements in the way of credits and farm loans while right in our midst lie millions of acres of rich soils in the lands along the creeks, rivers and lakes, that extend in an endless chain throughout the country. These lands require only proper drainage and protection from overflow to make them the garden spots of the world.

A certain amount of drainage work has been done among the higher rolling lands along the head-waters of many streams, but this work has been constructed to the detriment of the owners of undrained lands on the lower portion of the river. On these bottom lands more or less wide, the grade is small, the river is tortuous and the drainage work is most expensive and often times the cost is prohibitive. The lack of velocity or current in the river has caused bars and snags to form which hold back the flood waters until they have spent their energy by flooding the surrounding lowlands and at times the higher lands.

To obviate the flooding of these lowlands, levees have been constructed and pumping plants installed, and even these have been washed away.

These are the lands and areas that suffer from spring floods. They will continue to suffer until laws are enacted that will enable the entire watershed or catchment area to be treated as a single unit, beginning the work of reclamation at the mouth of the stream which should be dredged, straightened and cleared of snags and debris, and prepared as a waterway or barge canal as far as possible, thereby lowering the water-table which will drain the adjoining lowlands and create an outlet for the drainage of the higher lands. This work should be continued until every

individual branch has an outlet for complete drainage.

It is to remedy these conditions that the National Drainage Congress was organized to urge new legislation in order that the work might be done. Three interests enter into the benefits derived and the costs should be divided and borne by them in proportion to such benefits, namely, the national, state and county governments and the property especially benefited. Every avenue of commerce through which freight may be carried should be fostered and improved by the national government and whenever a stream may be made fit for use as a barge canal or commercial waterway, the cost of such should be borne by the government. Interstate streams, wherein the work may by reason of lowering of the watertable in the straightening of stream lines, furnish a natural waterway and drainage of adjoining property, the cost should be divided between the national, state and county governments and the property benefitted.

When you stop to consider the scope of the undertaking and the many interests involved you will readily see why no definite action has as yet been taken.

The theory of majority rule is now and has been the great factor that has held back and killed many a drainage scheme, for it must be remembered that the lowlands are in the minority, both in acreage and owners and until some scheme can be advanced to prove benefits to the higher lands, the organization of entire catchment areas into drainage districts by petition will be an impossible proposition.

The theory of benefits due to better sanitary conditions on account of drainage may be one element that may enter into consideration.

The fact that the increased value of reclaimed lowlands will add to their tax value, thereby reducing the amounts paid by the higher lands may be another element to include the higher lands.

Is it possible that we have been considering drainage of a catchment area as the only element that enters into the betterment of the entire community, and, like playing a tune on a single string of a violin, we have been unable to function, or would not obtain a better tune to play on all four strings and in our larger sphere combine all the elements that may enter into the reclamation and development of a certain area and by such a combination of elements have a legal reason to organize them into a single reclamation district?

There is another element more potent than any yet discussed that enters into this reclamation scheme that affects both the low and the high lands and the dweller thereon, and that is a potable water supply. Every community must depend on its own watershel for its water supply, and the demand for pure water may be used as a factor to prevent pollution of all streams and waters, and therefore conservation of our water supply may be accomplished as the first element, and by which the high and lowlands are equally benefitted; as the greater population live on the higher lands, yet look to the stream in the lower areas to obtain a water supply.

Inasmuch as during flood time the lowlands are flooded with the refuse of the higher land and become the breeding place of the disease-bearing mosquito, and decayed vegetation, is becomes necessary to eliminate the swamp areas that all the waters of a stream may be potable and free from the contamination, peculiar to swamp areas.

The conservation of a potable water supply may be that missing element through which all lands may be brought into the classification, "to be benefited."

A potable water supply is beginning to agitate many of our inland towns and cities as in many locations the available supply is not sufficient.

Special laws will have to be enacted in many states to enable this work to be accomplished, and I believe the possible productivity of the rich reclaimed swamp lands should be given greater weight than the worn-out soils of the higher lands. The percentage of owners and acres of land owned by the petitioners should be greatly reduced and the necessity and reasonableness of the improvement should be the questions involved and not the number of owners or acreage owned by them. In other words, you do not wait until one-third or one-half the population has contracted smallpox or yellow fever before you start to eradicate the disease, but, on the contrary, if one person is infected you jump to eliminate him, but diseased, sour, poorly drained lands, not able to pay taxes are left until one-half or one-third of the adjoining property owners consent to their reclamation.

The foregoing paper was presented by Mr. Rossiter before the recent annual meeting of the National Drainage Congress at Kansas City, Mo.

WELL DRILLING PRACTICE IN NORTH CAROLINA

By F. G. Godfroy, Superintendent Water and Light Department, New Bern, N. C.

The city of New Bern, N. C., has a series of four wells located in the center of a 70-acre tract and these wells have delivered on test over 2,500 gals. per minute, and as our normal requirements are about 1,330,000 gals. per day we have no need to worry about our supply for several years to come. We are drilling at the present time an additional series of wells to take care of the fire hazard, and when these are completed we will have a system that will take care of almost any situation that may arise.

Wells of our system located within 100-ft. of each other show but little loss of head when any one well is pumped to capacity; in one case an 8-in. well was pumped to 800 gals. per minute with a loss of head of only 24-in. in a well only 90-ft. from it.

One of the main things that a well driller should be sure of is that the bottom section of his casing is driven into the first stratum of rock that he encounters so that there will be no danger of any surface water seeping into the well. If this is not done, it makes no difference how good a supply of water one may get there is always the possibility of the supply becoming contaminated from this source. Most of the pollution in deep well supplies comes from this very cause. It is remarkable the distance that surface waters will travel through the ground and pollute a well supply.

When a suction pipe is installed inside the casing of a well care should be exercised to see that the top of the casing is properly sealed so that no dirt or rainwater can get in the well. As this part of the plant is seldom looked over it is frequently a source of trouble.

In the eastern section of this state, the drilling of wells is not a very expensive operation as we have seldom struck any very hard rock. Most of the rock encountered is a shell rock and is not very hard. We seldom encounter any granite. This enables us to drill wells at a very reasonable price, as it allows the use of a very light rig, and a great portion of the well can be washed down without any trouble until the first rock is encountered. Then we have to put in a drill to break up the rock and use a sand pump to take out the broken rock and dirt. The drill we have used with the best results in this soft rock is a home made drill a great deal like the old-time star drill long used to cut through brick walls. This is not so expensive as the regular spud and can be more easily sharpened and handled with the lighter rig as it is so much lighter than the ordinary string of drilling tools. With this tool we can generally make from 8-in. to 1-ft. at each drilling as this type of drill does not clog up and only quits cutting when the crushed rock gets deep enough so that the drill does not hit the hard rock when it drops.

Close to the surface this crushed rock is easily washed out if we have a supply of water available sufficient to overflow the casing, but at the lower depths we have to resort to the sand pump. This sand pump is made of a piece of pipe slightly smaller than the well casing with a bail on the top to fasten line, and in the other end a valve similar to the old leather valve used in the ordinary pitcher pump. The sand and rock is forced up into this pipe and then by raising and lowering the pipe the water is forced out of the top of the pipe and the sand and stone remain. This has to be raised to the surface and there dumped by hand, and this operation has to be continued until we can raise no more sand or rock and then the whole operation has to be gone over again.

We usually get the best results in washing down wells with a centrifugal pump as they are easier to handle and a pump of large capacity is not so cumbersome to carry around to the well location.

We usually dig a small surface well or sump and fill this with water from some outside source, provided we cannot get a supply by going down a few feet. The overflow is carried back to this sump and the water used over and over, so that a very small amount of water suffices for this work. We locate the sump a short distance from the well so that a ditch can be cut and the washings of rock and sand can be cleaned out of the way and the water run back into the sump.

We have not had to case any of our wells below the first stratum of rock as we have always encountered a fine grade of water bearing sand immediately we drill through the rock, that gave the wells the necessary capacity for our needs.

The foregoing matter is from a paper by Mr. Godfroy before the recent annual meeting of the North Carolina Section of the American Water Works Association.

Construction News and Equipment

IMPROVEMENT IN CENTER JOINTS FOR CONCRETE ROAD

By C. V. R. Fullenwider, M. Am. Soc. C. E., Manager Elastite Department, The Philip Carey Co., 40 Wayne Ave., Lockland, Cincinnati, Ohio.

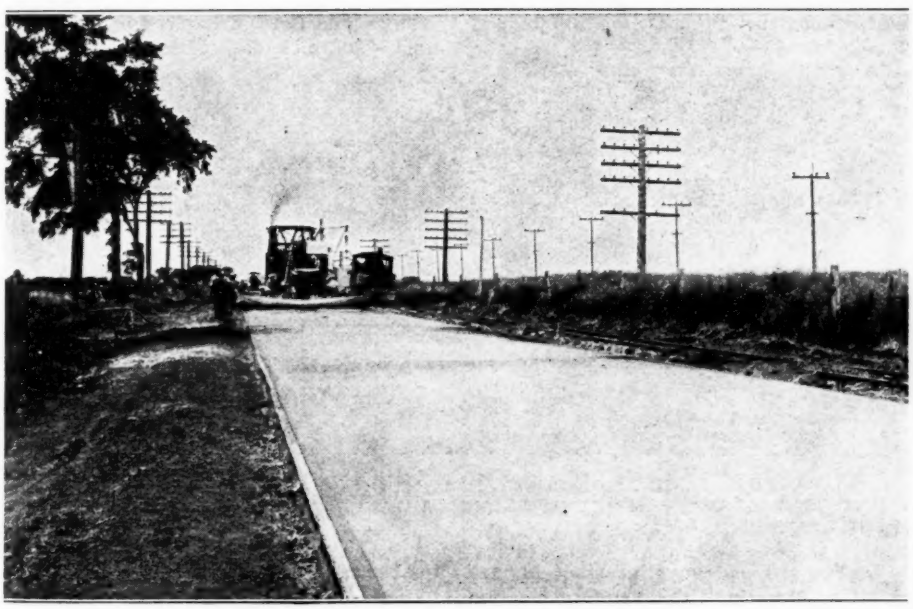
Use of a longitudinal central joint in concrete roads has become well established in many states. The principal advantages claimed for this construction are—first: the elimination of disfiguring longitudinal cracks; second: the ease with which the road may be built in two longitudinal halves, doing away with the necessity of providing and maintaining detours; third: the tendency of the joint to produce an automatic separation of the two lines of traffic. These facts have been amply verified through observation and experiment and are quite familiar to most highway engineers.

There have admittedly been several more or less serious disadvantages encountered in connection with the use of centering joints. These difficulties are being carefully studied and the underlying causes are becoming better understood. Recent developments in this direction have produced some rather startling results.

A logical approach to the matter of a better center joint naturally involves the question of what constitutes the perfect joint. United opinion on this point is doubtless as difficult to attainment as perfection itself. There is unhesitatingly submitted, therefore, the following list of properties, possession of which would in the writer's opinion enable a center line joint for concrete roads to approach very closely to the ideal:

1. It must be of such shape as to interlock adjacent concrete slabs in order to preserve uniform surface alignment.

2. It must interpose between slabs a compressible, yielding cushion. This pre-

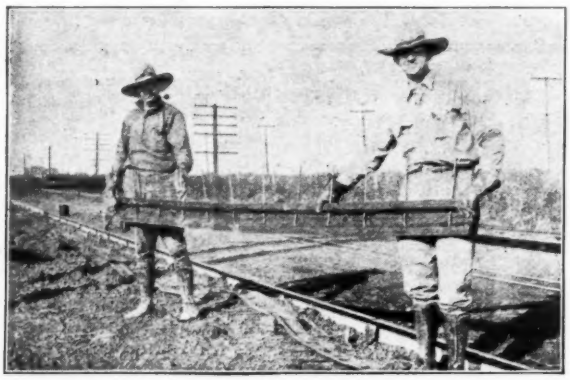


THE FIRST INSTALLATION OF ELASTITE TONGUE AND GROOVE EXPANSION JOINT.

Illinois State Road between Dwight and Gardner. Built July, 1922, by State forces in charge of H. W. Hartman, Superintendent, and C. E. Clark, Foreman; G. O. Consoer, Resident Engineer. The portion shown had center longitudinal joint only, which was submerged ¼-in. below the finished surface.

vents the edges of slabs from crushing and spalling at the joint.

3. Material and construction must be such that joint is effectively waterproofed.



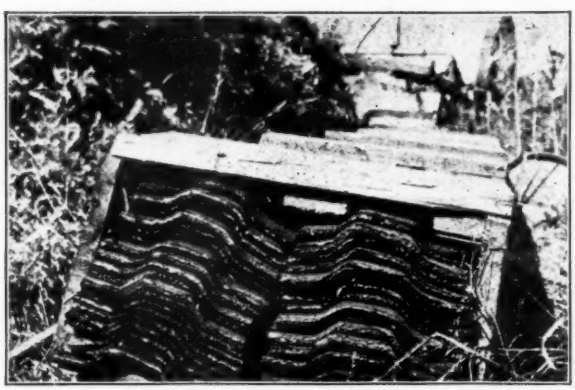
THIS SHOWS THE RIGIDITY AND STIFFNESS OF THE ELASTITE TONGUE AND GROOVE EXPANSION JOINT, EVEN WHEN CARRYING THE ⅝-IN. DIA. x 15-IN. LONG ROUND STEEL PINS. THESE PINS WERE PASSED THROUGH A JOINT AND DRIVEN INTO THE SUBGRADE TO SUPPORT THE JOINT MATERIAL IN POSITION.

4. It must be capable of simple and economical installation by common labor.

5. It must be so constructed that there exists no possibility of damage to vehicle tires, horses hoofs, or pedestrians, should any part of the joint become displaced during construction or exposed by wear of the concrete.

for center line use and recently put on the market in various thicknesses and widths. This product satisfactorily fulfills every requirement laid down in the preceding paragraphs, having the additional advantages of the felt and asphalt sandwich construction which has made the name "Elastite" famous.

Designed to interlock adjacent sections of concrete, it is fittingly called Elastite Tongue and Groove Expansion Joint. In the 1/4 in. thickness, it has sufficient body



ELASTITE TONGUE AND GROOVE EXPANSION JOINT AS RECEIVED ON THE JOB. END OF CRATE REMOVED TO SHOW HOW JOINT STRIPS NEST TOGETHER FOR SHIPMENT.

6. The life of the joint must be not less than the life of the concrete.

7. Maintenance costs must be at a minimum.

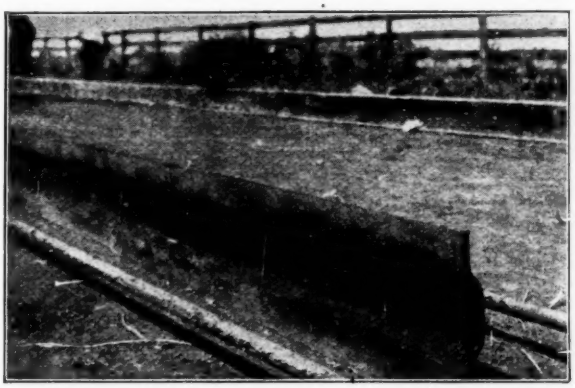
In this connection highway engineers will be much interested in the new form of Elastite Expansion Joint, developed to absorb any movements of the slabs due to settling of the subgrade or frost heaving. Edges of concrete in contact with it cannot spall or crush. Only a thin edge is exposed to traffic, avoiding any tendency toward rutting at the joint. If preferred, the joint may be concealed or submerged

below the finished surface. The tongue and groove feature prevents uneven settlement and maintains surface alignment, tending to prolong the life of the pavement and minimize maintenance expense.

READY FOR CONCRETE. TWO MEN PLACING A 10-FT. LENGTH OF ELASTITE TONGUE AND GROOVE EXPANSION JOINT; THIRD MAN INSERTING TRANSVERSE DOWEL RODS.

Installation is as simple and easy as with the ordinary types of joint. Almost any simple form of holder will do. A plank or a section of plate may be used, or the material may be supported by removable stakes. Perhaps the best method is the use of 1/4 or 3/8 in. steel pins about 15 ins. long, spaced at fairly close intervals. These may be passed through the "tongue" and driven into the subgrade, the tops being left 1 in. or so below the level of the concrete surface.

Elastite Tongue and Groove Joint has shown up so well in actual service tests that it has been officially approved and adopted as an alternate on Illinois State Roads for 1923. Installation costs have run astonishingly low as compared to other center line joints placed by the same crew of men under practically identical conditions. Other states contemplate trial installations next year. The new joint has aroused much genuine interest among those who have examined it, and its use in concrete roads is confidently expected to remove most of the objections to central longitudinal joints which have heretofore been exposed.



ELASTITE TONGUE AND GROOVE EXPANSION JOINT SET UP IN THE ROAD, SUPPORTED IN PLACE BY STEEL PINS DRIVEN INTO THE SUBGRADE, AND READY FOR CONCRETE.

While intended primarily for use longitudinally in roads, there is no reason for limiting it to this service. Installed transversely, 1/4 to 1/2 in. thick, it should be doubly efficient, functioning not only as an expansion joint but also securely keying adjacent slabs together in a firm yet flexible and watertight grip, permanently and without deterioration.

THE EVINRUDE CENTRIFUGAL PUMP

A product which is constantly finding new and unsuspected markets for itself is the Evinrude Centrifugal Pump, made by the Evinrude Motor Co., Milwaukee, Wis.

For the past twelve years this company has manufactured the famous Evinrude Detachable Rowboat Motor of which more than 150,000 have been sold. About six years ago one of the Evinrude engineers conceived the idea of installing this same dependable 2-H. P. Evinrude gasoline engine in a small, compact centrifugal pump. After months of improving and refining the new pump was perfected and quietly placed on the market.

Because of its compactness and portability it made quite a hit with the building contractor who had an occasional need for a pump to clear the water out of his excavation after a rainfall. One day a sewer contractor saw an Evinrude at work and decided to try it out for draining his trenches. Occupying a space only 16x23-ins. and weighing only 115 lbs., this remarkable little pump could be lowered right down into the ditch and be submerged in the water. There was no need for any "installation." The Evinrude could be used with or without a suction line.

EVINRUDE CENTRIFUGAL PUMP FOR CONSTRUCTION JOB PUMPING.

And so, one after another, new types of users for the Evinrude Centrifugal Pump have come to light. With its capacity of 5,000 gal. at a 20-ft. head and its built-in power plant it can do many kinds of jobs far more economically than larger pumps because its price and operating expenses are lower. For portability and adaptability, its makers claim it to be without a rival.

Today the Evinrude is known to more than a score of different industries. Bridge builders use it for emptying coffer dams and supplying water to the mixer or hoisting engine. Road contractors use it for pumping water in case of emergency. In quarries, gravel pits and mines the Evinrude solves one of the biggest problems—by supplying an efficient, economical means for disposing of drainage water.

Public service and street railway companies in a number of cities use the Evinrude for underground work. Because of its portability many fire departments use this handy outfit for pumping the water out of flooded basements.

Every sand dredge is equipped with a large sized Centrifugal Pump which must be primed. For this purpose an Evinrude is ideal because of its quick action and extreme compactness. Owners of scows and barges use the Evinrude for bailing out the hold.

Just recently a series of heavy rains threatened to spoil a county fair because a large portion of the fair grounds was low land. A crew of five men with large diaphragm pumps could make no headway, but an Evinrude Centrifugal Pump which was on display at the fair made short work of disposing of the excess water. The Evinrude is used by some people for watering lawns and gardens and on small irrigating jobs.

For users requiring a more powerful pump the Evinrude No. 1½ has been developed. This outfit pumps 7,400 gals. per hour at a 20-ft. head and is powered by a 3½-H. P. Evinrude Motor.

IMPROVEMENTS IN GRAMM PIONEER TRUCKS FOR 1923

Engineering and unit changes in Gramm-Pioneer trucks for 1923, by the Gramm-Bernstein Motor Truck Co., Lima, Ohio, are as follows:

Model 10, Speed Truck which has for the past 3 years proven very satisfactory when engined with a 3 1/2 x 5 motor will in future be equipped with a 3 3/4 x 5 motor which besides being built with a 5 bearing crankshaft of liberal dimensions, includes also all of the latest up-to-date post-war motor engineering and building practices, such as full force feed oiling to all bearings through drilled crankshaft, by means of gear driven oil

Start *now*—
to work for Good Roads!

IT'S none too early. Spring—the season when actual operations must begin—is just over the hill. Plan now to have the Tarvia Truck working in your community this year.

Tarvia roads are moderate in first cost and more economical to maintain than any other type of highway that will stand up under modern traffic. Their non-skid surface is smooth, dustless and mudless all the year round.

Call on our Special Service Department. The experience of skilled highway engineers—based on intimate knowledge of every type of road construction—is freely at your service.

Please address your letter to our nearest branch. It will receive prompt and careful attention.

Visit our Booth at the A. R. B. A. Road Show, Chicago, Jan. 15th to 19th

New York Chicago Philadelphia
Cincinnati Pittsburgh Detroit
Minneapolis Dallas Salt Lake City
Toledo Columbus Richmond
Denver

The Barrett Company

Boston St. Louis Cleveland
New Orleans Birmingham Kansas City
Atlanta Bangor Youngstown
Baltimore Omaha Houston

THE BARRETT COMPANY, Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N.S.

pump, removable head, hot spot manifold, high sight oil gauge, all moving parts enclosed, etc., together with extreme simplicity and acessibility of all parts.

Due to the universal tendency of users to overload far beyond manufacturers' ratings, the rear axle has been increased in size in such essential parts as bevel gear, pinion, differential, carrier and bearings and an additional annular has been located at the lower or bevel end of the pinion to assist in taking care of the strains of severe service.

Model 65, 1 1/2-2 ton worm drive formerly engined with continental Red Seal Model N, 3 3/4 x 5 will in future carry their new J-4 motor of same size but with all of their latest improvements of drilled crankshaft, gear driven oil pump, force feed oilings, hot spot manifold, etc.

While this model will continue to be regularly built with North East generator and distributor ignition from Exide Heavy Duty truck type battery, it will also be furnished with Eisemann High Tension Magneto Ignition, in connection with electric lights and horn, as an extra.

The emergency brake which formerly operated on rear brake drums will hereafter be of ventilated shoe type and operate on the front propeller shaft, leaving double the braking surface in rear drums available for the foot service brakes, thus insuring easier and better control, with less wear on brake linings.

Model 20, 2-2 1/2 ton worm driven: In this capacity they will replace the former Continental Red Seal C-2, 4 1/8 x 5 1/4 with their latest Red Seal K-4 of same size, which model also includes all of the latest improvements already recited for the J-4 motor.

Due to the unqualified satisfaction which North East generator with distributor and Exide Battery ignition has given in this Model also, its use will be continued regularly, but buyers may have the option of Eisemann High Tension Magneto Ignition, in connection with electric lights and horn, at an extra price.

Emergency brake will also be changed from rear drums to propeller shaft and the double braking surface in rear drums will be used for service braking, as described for the Model 65, 1 1/2-2 ton.

On account of the increased demand for 2-2 1/2 ton capacity for dump truck and similar exceptionally severe service, frame dimensions have been increased to 6x2 1/2x¼-in. and the front end will also be provided with an integral type of channel bumper.

Along the lines of seeking greatest user economy in operation the manufacturers will extend their former practice of equiping heavy duty Models (3 to 6-ton) with Gramm's patent Fuel Economizer, to the Model 20 also, without extra charge.

Models 65 and 20 will be furnished regularly with storm proof cabs with fore doors, or will be equipped with fully enclosed vestibule cabs, at a moderate extra price.

THE HUG SPEED TRUCK FOR ROAD BUILDERS

The Hug Speed Truck is a product of several years' of road building experience. Mr. C. J. Hug, a successful road contractor, realized the need of a motor truck especially adapted to road building service. He first designed and constructed an experimental truck for use on his own road contracts and the remarkable performance of this experimental truck under actual working conditions, its economy of time and money, dependability, efficiency and its practical service, led to the formation of a company to manufacture this truck and other road building equipment, The Hug Co., of Highland, Ill. The truck was built right into the road job for the job and designed throughout to meet the exceptional conditions existing on road construction work.

The fact that Mr. Hug experienced more or less grief with various makes of trucks on road construction work presented an opportunity to observe the various types of satisfactory and unsatisfactory units of the several different makes of trucks and enabled him to judge the proper weight and capacity of trucks available on the ordinary subgrade.

After these facts had been determined, an effort was made to obtain the proper units from the different parts manufacturers which were necessary to assemble the experimental truck to meet the conditions and do the work most economically. After a careful search among parts manufacturers it was found a number of the essential units were not being manufactured and it was therefore necessary to make those parts specially.

Records obtained from the many fleets of Hug Speed Trucks in operation today are indeed gratifying and particularly inasmuch as the truck has proven very successful wherever used. Some of these records are as follows: 51 cts. per

square yard, including all labor and operating costs on 16½ miles of pavement, on a job where the Hug Truck, Hug Turntable and Hug Subgrading Machine were thought out and developed. The result of this achievement was demonstrated on the Powell-Gavin Co. job near Waterloo, Illinois, where all Hug equipment was used with Hug idea of plant layout. A cost of 23 cts. per square yard is reported, or would represent a total saving on 16½ miles (laid with the kind of equipment used in common practice) of $41,160. The hauling cost on this latter job amounted to 6½ cts. per ton-mile for the entire job.

The truck was designed to carry either a six-bag batch of wet mixed concrete or dry aggregate. It has been repeatedly demonstrated that with the use of a central mixing plant and light speedy motor trucks to distribute mixed concrete direct to the subgrade, a concrete highway can be constructed rapidly and economically and meet—the most rigid specifications. The advantage of this method of construction is that the investment of the equipment is less than where some other methods are used.

The Hug Speed Truck with ample speed, a maximum speed of 45 miles per hour, and unusual power when required on road and grade, is able to meet the most exacting conditions encountered upon road construction work. The balanced position of the body on the truck is a special feature. Bodies of other designs may be substituted for this special body when the truck is not required for road work and the truck then is a speedy truck for general utility purposes.

PAVING OF MODEL SECTION OF LINCOLN HIGHWAY COMPLETED

The paving of the Ideal Section on the Lincoln Highway in Indiana, 37 miles south of Chicago and adjoining the Illinois state line, has been completed. Much remains to be done before the section is ready for dedication as the most ideally designed and constructed link in the transcontinental road, but the 40-ft., reinforced concrete surfacing, 10-in. thick, is finished.

The Section will not be open for traffic until the completion of the two bridges, which are expected to be finished before the first of the year. Stone & Webster, Inc., with headquarters in Boston, Mass., one of the Founders of the Lincoln Highway Association and that organization's main contractors, pushed the paving work with the utmost speed consistent with the highest possible quality of pavement, in an endeavor to complete the job in 1922. In this they had the fullest co-operation of J. C. O'Connor & Sons, the subcontractors, and of Lockwood, Greene & Company, Engineers, also Founders of the Lincoln Highway Association, as well as its engineers.

Final Touches in Spring

The completion of the pavement and the bridges does not by any means complete the Ideal Section. Early in the spring the proper grading of the shoulders, the landscaping of the right-of-way and the installation of the gravel pathway for pedestrians will be undertaken under the supervision of Jens Jensen of Chicago, the Association's landscape architect. The installation of the modern lighting system for night travel, designed by the illuminating engineers of the General Electric Company, will also be delayed until spring, but the heavy work of grading and paving is out of the way, and already the Model Section gives an indication of its ultimate appearance. It curves along the slight ridge formed by the once south shore of Lake Michigan, through dense growths of ancient oaks, between which from time to time glimpses can be caught of the open farmlands.

The Ideal Section, in addition to exemplifying the highest development of modern road design and construction, is located in an ideally beautiful spot, which offers infinite posibilities for the ultimate development of a campsite and rest-station for tourists which will become nationally known as a model for development all along the 3,300-mile road.

Section Repays Study

Those interested in modern highway design and construction will find even now much to see and study at the Ideal Section site, which is being visited monthly by many highway engineers and officials from every section of the Union whose business brings them to Chicago and who take occasion to inspect the progress on the most famous section of American road-building.

Leading engineers have expressed the belief that the 40-ft. paving laid on the Ideal Section of the Lincoln Highway will carry the traffic for which it was designed for an indefinite number of years without the slightest damage to the roadway.

Maintenance cost will be negligible. The actual cost of the paving was $62,000 per mile.

USING GRAVEL ON SECONDARY ROADS IN ILLINOIS

By B. H. Piepmeier, formerly Engineer of Construction, Illinois Division of Highays, Chief Engineer Missouri State Highway Department.

Gravel roads are economical, especially on secondary roads, when it is possible to secure gravel at a low cost.

On account of the change in traffic and traffic requirements, gravel road construction and maintenance have changed somewhat during the past few years. Experience has shown that it is possible to maintain a gravel surface in a satisfactory condition even under moderately heavy traffic, if the road is built properly and is maintained at the right time and in the right manner.

A few years ago it was considered advisable to utilize large pebbles in the building of a gravel road, and a large per cent. of clay binder (from 10 to 20 per cent.) to insure proper binding of the surface. Conditions have now changed to such an extent that the smaller material (1 in. and under), with practically no clay binder, proves more satisfactory. The gradation that affects the quality of the gravel more than anything else is the material passing through a ⅛-in. screen. If 100 per cent. of the material will pass through a 1-in. screen and 90 per cent will be retained on top of a ⅛-in. screen, and is free from binding material, the gravel surface can be maintained in a smooth condition by the use of the light maintenance grader or road drag. Should the gravel contain a large per cent of material over 1-in. in size, together with a large per cent of clay, it will prevent reshaping of the surface, and the result is that deep ruts and pockets will readily appear, thereby making it difficult to keep the surface in shape.

Another vital mistake that has been made in much gravel road construction is that of building the road with an excessive crown. An excessive crown forces the traffic to the center and this results in rapid rutting of the road. The most satisfactory cross-section for gravel road construction, under moderate traffic, is to build the roadbed from 26 to 30 ft. in width, with a perfectly flat surface, or a crown not to exceed 2 or 3 ins. On this roadbed 8 ins. of gravel should be spread over a width of 18 ft., and shaped so as to give a finished crown on the gravel of not to exceed 4 ins. The flat crown will permit traffic to spread over the entire metaled surface, and thereby prevent rutting and add materially to the life of the gravel surface. Material that is free from binder will rut very badly; hence it is much better to apply but 2 or 3 ins. of the material at a time, allowing each layer to be thoroughly compacted by traffic before the succeeding layer is applied. Where gravel roads are built by contract it is usually more desirable to have all of the material delivered on the roadbed during construction. When this is desired it would be advisable to dump the surplus material along the edge of the surface, where it could be readily dragged into place as the gravel becomes compacted under traffic.

When it is unnecessary to ship in gravel and the material contains from 10 to 15 per cent clay binder, the road should be built by first applying 5 or 6 ins. of the gravel and allowing the traffice to compact it thoroughly, after which it could be surface-treated with another application of the gravel, ranging from 2 to 4 ins. in thickness, depending upon the character of traffic that is going to use the road. The clay binder in the gravel is not so objectionable when the material can be hauled directly from the pit to the road. However, it is not possible to maintain the surface of the road in as good a condition when it packs under traffic. When gravel is to be shipped or hauled any distance it is very foolish to pay for transportation on clay, as there is usually plenty of the same binder on the subgrade of the road.

Approximately 75 per cent of the value of a gravel road depends upon the way it is maintained. Under our organized patrol maintenance, therefore, it is possible to utilize practically any local gravel that may be available and make a satisfactory wearing surface for secondary roads.

A general specification cannot be written to meet all conditions in gravel road construction. It is better, therefore, to study the pit from which the roads are to be built and then write a specification for the particular pit that will give the most satisfactory road.

The foregoing matter is the text of the discussion of the subject, "Gravel Road Construction," by Mr. Piepmeier, at the 1922 annual Highway Short Course held at the University of Illinois, at Urbana.

Contracts Awarded

ROADS AND STREETS

Ala., Union Springs—D. R. Cook & Co., Montgomery and Selma, Ala., awarded contract by St. Hwy. Dept., for 18.6 miles 16-ft. gravel rd. bet. Union Springs and Montgomery, F. A. P. Nos. 1 and 68, at $326,228.

Ariz., Yuma—White & Miller, Yuma, awarded contract for paving 4.2 miles Hwy. on Yuma Valley Hwy. from Yuma, so., involving 329,294 sq. yds. 5-in. asph. conc. base and wearing surface, 15 ft. wide, at $582,853.

Cal., Los Angeles—Geo. J. Bock, Box 162 Palms, awarded contract by Co. Supvrs. for impvt. of Pine Ave. and Flora Ave. at $39,294 (abt. 2.6 miles); Bd. Pub. Wks. let contract to Tryon & Brain, 301 Tajo Bldg., for paving Orchard Ave. at $4,538; Geo. R. Curtis, 2440 E. 26th St., contract for paving Vanowen St., at $30,127, also at $2,241 for paving Mariposa Ave., and at $114,417 for paving 16th St. and other streets in 16th and 7th Ave. Imp. Dist.; G. T. McLain, 1184 N. Berendo St., awarded contract for paving portion of Ambrose Ave., at $7,024; Wm. Liddington, 420 E. 6th St., for paving Norton Ave., Pico St. to 1,100 ft. so., at $10,073; Geo. H. Oswald, 366 E. 5th St., contract for paving portion Lexington Ave., at $44,095; Baker & Kinsman, impvt. of 1st alley so. of Montana St., at $1,354; C. W. Shafer, contr. at $6,790 for constr. of 31,294 sq. ft. cement walk in Pacific Ave., at $6,790; Geo. R. Curtis, 2440 E. 26th St., contr. for impvt. of portion of Normandie Ave., at $23,004.

Cal., San Diego—Gilmore-Wilton Co., 25 14th St., San Diego, awarded contract for paving Adams Ave., Works Ave., 30th and Utah Sts., at $82,258; H. G. Fenton, 10th and L Sts., San Diego, contr. for grading and constructing walks on Greeley Ave., at $2,355; Geo. R. Daley, 4430 Boundary St., San Diego, awarded contract for paving Granada Ave., Redwood St. and alley in H. Gurwell's sub., at $17,357.

Cal., Santa Barbara—C. H. Hudson, Marsh-Strong Bldg., Los Angeles, awarded contract by U. S. Bureau Pub. Rds., for constructing Cuyama Rd., 15.1 mi. in Santa Barabara and San Luis Cos., at $491,692.

Fla., Dade City—J. G. Yeats Co., Tampa, awarded contract to build 3 sections road from Dade City to West Coast Section, to lay found. and grade, entire road and surf. two-thirds on Eastern portion; Finley Method Co., Jacksonville, awarded contr. to surf. one-third on Western portion; $500,000; sheet asph. and Finley method.

Fla., Clermont—J. B. McCrary Const. Co., 3rd National Bank Bldg., awarded contract for paving 23 blocks, at $103,433.

Fla., Pensacola—C. A. Fulghum, Pensacola, awarded contract for 10 mi. rd. from here to Roberts on Pensacola-Flomaton Rd. Escambia Co., Proj. 34, at $270,264.

Fla., Tallahassee—Maule Paving Co., awarded contract for surfacing with bitum. macadam 7.76 mi. road from Vero to Wabasso, Proj. 36, St. Lucie Co.; Ojus, $240,221; surfacing with plain conc. 10 miles road from Pensacola to Roberts, Proj. 34, Escambia Co., to C. E. Turner Co., Pensacola, at $250,808.

Fla., Tampa—Hillsborough County Commrs. let following contracts: 4.78 mi. Seffner-Thonotossassa Rd., asph. blk, concrete curb, to Warren-Carroll, at $74,455; 6.75 mi. Temple Terrace Rd., asph. blk., conc. curb, to Bruen-Sullivan, at $146,981; 14.25 mi. Interbay-Peninsular Rd., asph. blk. conc. curb, to Cone Bros., at $331,466; .75 mi. Bay Blvd., asph. blk., conc. curb, to Cone Bros., at $8,391; 10.90 mi. Plant City-Thonotossassa Rd., sheet asph., to J. G. Yeats Co., at $135,029; 6.55 mi. Midway Rd., sheet asph., to J. G. Yeats Co., at $88,845; 3.56 mi. Armenia Ave., asph. blk., conc. curb, to Cone Bros., at $79,823; 2.02 mi. Waters Ave., asph. blk., conc. curb, to Bruen-Sullivan, at $45,156; 6 mi. Lake Magalene Rd., sheet asph., to J. G. Yeats Co., at $72,795; 27 mi. Ruskin Rd., asph. blk., conc. curb, to Warren-Carroll, at $647,859; 2.35 mi. Wimauma Rd., asph. blk., conc. curb, to Warren-Carroll, at $37,006; all contractors of Tampa; McDonald Constr. Co., Orlando, Fla., awarded following contracts: 14.74 mi. Hopewell-Tampa Rd., asph. conc., at $260,397; 17.11 mi. Plant City-Picnic Rd., sheet asph., at $245,824; 15.13 mi. Citrus Park Rd., asph. conc., at $263,515; 11.16 mi. Lithic Rd., sheet asph., at $114,761.

Fla., Tavares—Bryson Live Stock Co., Jacksonville, Fla., awarded contract to construct 10.3 mi. sand-clay Lake Shore Drive Rd. bet. Eustis and Mt. Dora thru Tavares, at $86,375.

Fla., West Palm Beach—Palm Beach Co. Commrs. let contracts for oiling 3 sections of roads as follows: 14 mi. Ocean Blvd., Crocker's Pl. to Delray, 125,050 sq. yds. to A. C. Greynolds, W. Palm Beach, at 9½c sq. yd.; 7.5 mi. Ocean Blvd., bet. Delray and Boca Ratone, 67,000 sq. yds., to Maule Paving Co., Ojus, Fla., at 10c sq. yd.; 11 mi. new rd. near Stuart, to Maule Paving Co., at 10c sq. yd.

Ga., Atlanta—State Hwy. Dept. let following contracts: Wilkes Co., 10.15 mi. rd. from Washington to Lexington, to W. C. Hill, Abbeville, S. C., at $37,342; 6.7 mi. rd. from Tignall to Little River, to Nicholas Constr. Co., Atlanta, at $35,945; Wilkes Co., 7.2 mi. rd. from Washington to Thomson, to Stanley & Singer, Lafayette, Ala., at $35,063; Wilkes Co., 10.6 mi. rd. from Washington to Lincolnton, to Oglesby & Stark, Elberton, Ga., at $71,467; Cook Co., 6.85 mi. of rd. bet. Adel and Valdosta, to L. H. Smith, Elberton, at $77,676; Early Co., 63 mi. rd. from Proj. 196 to Proj. 264, conc. paving, to Davis Constr. Co., Macon, Ga., at $17,964.

Ill., Quincy—Sternberg-Powell Co., 37 W. Van Buren St., Chicago, awarded contract for Tarvia paving on Monroe St., at $46,850, Madison St., $46,612; alley bet. 3rd and 4th Sts. and Maine and Hampshire Sts., conc., at $1,363.

Ind., Indianapolis—State Hwy. Dept. has let contracts at total cost of $1,167,928 as follows: Michigan Rd., So. Bend to St. Joseph Co. line, 10½ mi., to Geo. M. Gross Constr. Co., Laporte, at $189,263; Range Line Rd., Carmel to 3 mi. so. of Tipton Co. line rd. to Miller & Miller, Elkhart, 12 mi., at $238,393; Range Line rd., 3 mi. so. of Tipton Co. line rd., to 9 mi. no. of the road, 12 mi., to Madison Constr. Co., Anderson, at $214,550; Lafayette Pike from Salt Lake Rd. to 2 mi. no. of Royalton, 11½ mi., to Geo. T. Miller, Lebanon, at $218,010; French Lick Rd., Dale to the Warwick Co. line, to McBride & Neibert, Columbus, 11½ mi., at $26,194; French Lick Rd., Hayesville to Crystal, Foulke's Constr. Co., Terre Haute, 9 mi., at $239,985; French Lick Rd., Crystal to 2 mi. west of French Lick, 6½ mi., to Edgar Traylor, Evansville, at $41,529. McBride & Neibert contr. is for culverts, bridges and other road structs. only; Traylor contract is for bridges, culverts and other road structs. and grading. All other contracts are for paving with conc. except the Foulke's Constr. Co. contract, the Hwy. Dept. providing the cement. Contracts for last two rds. have not yet been signed due to dispute over right-of-way near Jasper.

Ia., Burlington—Matthes Coal & Constr. Co., Davenport, awarded contract for paving at $61,490.

Ky., Louisville—Following contracts let by State Hwy. Dept.: Louisville-Paducah Rd., Crittenden Co., to Brantley & Costello Bros. Co., Knoxville, Tenn., 8.8385 mi., at $86,493; J. W. Harris Cont. Co., Covington, Ky., at $96,827 on macadam and pipe; to Southern O. & T. Co., on surf. treatment at $9,293 on 9.55 mi., Vanceburg-Maysville Rd., Lewis Co.; 17.045 mi. Louisville-Paducah Rd., Livingston Co., to Ellis & Smeathers, at $120,600, rubble masonry and vit. pipe; also Frenchburg-W. Liberty Rd., Menifee Co., at $82,259, rubble masonry and conc. pipe, also same contractors for 5.018 mi. Stanton-Winchester Rd., Powell Co., at $59,869, rubble masonry and conc. pipe. Contractors located at Owensboro, Ky., Southern Oil & T. Co., at Louisville.

La., Baton Rouge—State Hwy. Comn., let contract for 16.1 miles Winnsboro-Vidalia Hwy., Franklin Parish, to W. H. Harris, Monroe, at 91,780; 4.03 miles Crowley-Kaplan Hwy., Acadia Parish to W. H. Harris, Monroe, at $91,780; 4.03 miles Crowley-Kaplan Hwy., Acadia Parish to Howard Kenyon Dredging co., Dallas, Tex., at $25,252; gravel for Crowley-Kaplan Hwy., Acadia Parish to Fluker gravel Co., Fluker, at $11,354.

La., Baton Rouge—La. Hwy. Comn. let contracts for road work as follows: 3 miles gravel rd. on Jefferson Hwy. from Molville to Port Allen, to Maggio-Attello-E.. Baton Rouge, at 324,652; 18.5 mi Tallulah-St. Joseph Hwy. to S. A. Gano, New Orleans, at 220,756; 6.21 mi. Greensburgh-Finker Hwy.

to Kentwood Gravel Co. Kentwood, La. at $67,659.

La., Monroe—Meyer-Greenwald Constr. Co., Meridian, awarded contract by La. Hwy. Comn., Baton Rouge, for grading construction draing. structs. and gravel surfacing 16.7 miles Monroe-Rushton link of Dixie Hwy., Ouachita Paris, Proj. 114, Sec. B, at $136,390.

La., Sumner—Bryant Asphalt Co., Waterloo, awarded contract for 58,000 c. y. Warrenite bitulithic paving and 34,000 c. y. curb and gutter, at $209,936.

Mass., Boston—Lane Constr. Co., 37 Colony Bldg., Meriden, Conn., awarded contract by State Bd. of Public Works, St. House, for paving 8 mi. highway, 17-ft., bet. Otis and Sandisfield; 225,280 sq. yds. bitum. macadam, at $307,415; also contract for 4,221 ft. road, 20-ft. bitum. macadam, in Ashburnham, at $31,502.

Mich., Lansing—S. J. Groves & Sons Co., Duluth, Minn., awarded contract for Rd. 48-8, Mackinac Co., Hendricks Twp., Cl. E waterbound macadam, 16-ft. wide, 5,080 mi., at $77,630; Menominee Co. Rd. Comn., Menominee, awarded contract for Rd. 10-11 B Ext., Menominee Co., Menominee Twp. Cl. C stepne. gravel, 16-ft. wide, 0.311 mi., at $4,672.

Mich., St. Ignace—S. J. Groves & Sons, 120 Manhattan Bldg., Duluth, awarded contract for surfacing Road 48-8 with waterbound macadam, 16-ft. wide, at $77,630.

Mo., Bethany—Rand Constr. Co., Bethany, awarded contract for 4 mi. conc. rd. west of Bethany and for erection of bridge across Big Creek, at $142,392.

Mo., Charleston—R. C. Williams, Wyatt, Mo., awarded contract for 14 mi. rd. so. of Anniston and 10 mi. so. of Charleston, at $570,000.

Mo., Jefferson City—State Hwy. Dept. let contracts for 13 sections as follows: Franklin Co., 6.638 mi. sects. 66 and 67, to Frazier Davis, St. Louis, Mo., at $47,400; Miller Co., 4.991 mi. Sec. 56, to Fogloman, Thompson, Eugene, Mo., at $19,749; Miller Co., 4.078 mi. Sec. 57, Fogleman, Thompson, at $14,443; St. Charles Co., 7.555 mi. Sects. 68, 69 and 71, to S. M. Timberlake, Indianapolis, Ind., at $319,019; Caldwell Co., 9.868 mi. Sects. 12 and 13, to Harrison Engrg. Constr. Co., Wichita, Kans., at $425,298; Butler Co., 10.47 mi. Project 204-A and B, to Robertson & Taylor, Poplar Bluff, Mo., at $329,000; Jefferson Co., 8.144 mi. Sects. 2 and 3, to W. J. Knorpp and Jas. Richardson, De Soto, Mo., at $47,362; Doehle & Kollmeyer, Jefferson City, contract at $41,652 to gravel 4.062 mi. 12-ft. road, Montgomery Co., Proj. 141.

Mo., Liberty—Capital Construction Co., 1207 Cherry St., Des Moines, awarded contract for 2 sections of road from No. Kans. City to Gashland, at $332,500, 8.588 miles conc. pavement.

Mo., Poplar Bluff—Robinson, Ellis & Taylor, Poplar Bluff, awarded contract by State Hwy. Dept., for 10 miles 18-ft. conc. road from Poplar Bluff to Fisk, at $329,000.

N. J., Mays Landing—C. M. Earle, 173 Main St., Hackensack, awarded contract for reconstr. of Cedar and Landis Aves., from May's Landing-Downtown Rd., to Richland, to line bet. Atlantic and Cumberland Cos., at $211,980.

N. C., Washington—P. R. Ashby, Raleigh, N. C., awarded contract for bldg. 4.8 miles road from Chocowinity toward Aurora, at $223,594.

N. C., Wilmington—F. J. McGuire, Norfolk, Va., awarded contract for 70,000 yds. bitulithic paving, at $200,000.

Pa., Ebensburg—McClure & Binger, Johnston, awarded contr. for reconstructing 161,000 lin. ft. Wilmore Rd., vit. brk. on conc., at $175,062.

Pa., Harrisburg—Following contracts let by State Hwy. Dept., 20,088 ft. Route 333, York Co. and 22,806 ft. Routes 260 and 233, York Co., to Kumer & Graber, Shamokin, at $215,365 and $261,549, respectively; 1,921 ft. Application 1,958, Jefferson Co. to W. C. Quick, Brookville, at $43,511; 24,077 ft. Route 226, Application 1,523, Lehigh Co. to Junanita Co., 410 Empire Bldg., Phila., at $169,633.

R. I., Providence—State Bd. Pub. Rds., Providence, let contract to Lane Constr. Co., 37 Colony St., Meriden, Conn., for paving 1.32 miles Smithfield Ave., Pawtuxet Ave. to Lonsdale Ave., in Lincoln, at $57,997; 1.8 mil. Ten Rod Rd., from Wickford Jct. easterly to Tower Hill Rd., No. Kinston, at $43,441; Greenough Constr. Co., So. Acton, Mass., 2.46 mi. Kingston Rd., Usoquepang to W. Kinston Sta., at $53,783; B. C. Jordan, 1244 Elmwood Ave., Providence, 2.05 mi. Apponang Rd. from Pawtuxet brdg. to Elmwood Ave., in Warwick, at $58,040.

Tenn., Nashville—State Hwy. Dept. let contract for surfacing with 1½-in. rock asph. on 8-in. hand placed base course F. A. P. 37, Campbell Co., and 9.8 miles rd. from point nr. Newport to N. C. state line, 8-in. hand placed base course, Cocke Co., to H. L. Humbard Constr. Co., Jacksboro Park, Knoxville, at $13,966 plus 10% for engr. and contingencies and $228,058, respectively; bridges on same project to A. Lyons, Roversville, $10,752.

Tex., Beaumont—Smith Bros., Crockett, Tex., awarded contract to improve 2 roads as follows: 15.53 mi. pavement on conc. base and asph. topping on Nome Rd., at $663,008; also 7.35 mi. same type pavement on Voth Rd., at $273,032.

Tex., Hidalgo—W. L. Pearson & Co., awarded contract by Hidalgo Co. for base, and Smith Bros. contr. for topping, at $500,000 for bldg. 14 miles state hwy. No. 12, Edinburg to Val Verde; gravel and crushed stone base, rock asph. top; F. A. P. No. 301.

Tex., Laredo—Peterman, Robinson & Neyland, Laredo, awarded contract to gravel 110 miles of road from Laredo to Mirando City and Oilton, at $150,000.

Tex., Marlin—Hannah Constr. Co., Box 994, Waco, Tex., awarded contract to build 9.22 miles State Hwy. 44, Falls Co. to furnish gravel surfacing; $80,354.

Va., Richmond—Ford & Harvey, Lynchburg, awarded contract by St. Hwy. Comn., for 5.5 miles conc. rd. from Franklin to Carrsville, Nansemond and Isle of Wight Cos., at $173,961; 1.74 miles rd. from Washington's old home, Westmoreland Co., to intersect with Route 7, to B. W. Pomeroy, at $12,289.

Vt., Montpelier—Atwood, Thomas Constr. Co., Middleboro, Mass., awarded contract for Highgate Fed. Aid Proj. 34, at $40,964; A. V. Leo Constr. Co., Thompson, Conn., contr. for Danville Fed. Aid Proj. 26, at $115,289.

Wash., Seattle—Hauge & Espaland, awarded contract for paving, trestles, etc., on Railroad Ave., at $96,185.

Wyo., Casper—Warren Constr. Co., awarded contract for bitulithic paving in Dist. No. 25, at $88,000.

Wyo., Lander—Wickham Bros. & Schweiger, Lovell, awarded contract for constr. of Yellowstone hwy. bet. Boysen and Bonneville, 8½ miles, at $103,000.

SEWERAGE AND SEWAGE TREATMENT

Cal., Alhambra—Cox & Teget, 427 S. Marguerite St., Alhambra, awarded contract for installing sewers in Sewer Dist. No. 1, embracing territory no. of Alhambra Rd. and west of Garfield St., at $27,442; 8-in. sewers, manholes, jct., chambers and flushtanks (vit. pipe).

Cal., Los Angeles—Chas. U. Houser, Hotel Clark, Los Angeles, awarded contract for constr. of Sec. 4 of temp. outfall sewer bet. Rimpau Blvd. and Ballona Crk., at $124,500.

Cal., Santa Ana—J. Chutuk, Bullard Bldg., Los Angeles, awarded contract by cities of Santa Ana, Orange, Anaheim and Fullerton for constr. of outfall sewer line to ocean, at $138,855.

Cal., Santa Monica—J. D. Kneen, Dudley Blk., Santa Monica, awarded contract for constr. of sewer in Orchard Tr., at $15,000.

Ont., Hamilton—McLaughlin Bros., 574 Somerset St., Ottawa, awarded contract (general) for constr. of storm and sanitary sewer, at $96,220, on Kenilworth Ave.

Ont., Toronto—General contract for sewers and pumping st., costing $43,000 for city, awarded to F. F. Fry, Ltd., 43 Scott St.; Murphy Contracting Co., 84 Dominion St., awarded general contract for sewers; F. F. Fry, Ltd., 43 Scott St., awarded contract for sewers in Boulevard Pl., at $20,312; Riverdale and Duplex Aves., $8,056, National Contracting Co., 9 Garnock Ave.; Dundas E., to J. H. McKnight Constr. Co., So. St., David St.

Fla., Jacksonville—City let following contracts for storm and san. sewers: Sec. A, Bryan & Co., at $20,881; Sec. B, Stevens St. outfall, Adams, Evans & Co. and Wills Sons & McCarthy, $32,433; Bismarck outfall, Bryan & Co., $9,235; Sec. C, Adams, Evans & Co. and Wills Sons & McCarthy, $18,301;

Sec. D, Adams, Evans & Co., $47,213; Sec. F, Adams, Evans & Co., and Wills Sons & McCarthy, $23,373. U. S. Cast Iron Pipe and Fndry Co., Burlington, N. J., awarded contr. for furnishing cast iron pipe; Jacksonville Concrete Products Co., contract for conc. pipe.

Ky., Louisville—Henry Bickel Co. awarded contracts for Speed Ave. lateral sewers and for Payne St. sewer at approx. $60,000.

Mich., Ferndale—Contract for lat. sewer in alley bet. Vester and Rockwell Aves. to L. Kovorkian, 555 Paddock Bldg., Pontiac, at $3,040; sewer in Hazelhurst Ave. west and lat. sewer in blk. bounded by Hilton Rd., Woodward, Silman and Jewell Aves., to Hammer & Co., 516 Garfield Bldg., Detroit, at $7,996; lat. sewer in alley bet. Breckenridge, Cambourne and Michelson Aves. to Cappello & Fatore, 2161 Hale St., Detroit, at $7,900; laterals in Saratoga Ave., blks. bet. Vester, Rockwell and Bermuda Aves. and Wolcott, Burdette, Lewiston and Drayton Aves., to Halpin & Reilly, 304 W. Bancroft St., Toledo, Ohio, at $11,277.

Mich., Grosse Pointe Farms—(Detroit P. O.)—V. Teetaert, 448 St. Clair Ave., Detroit, awarded contract for 3,500-ft. vit. crock sewer in Kerby Rd., W. Ridge Rd. to Black Marsh Ditch, at $25,000.

Minn., Amboy—Gedney & Murphy, 211 Lumber Exch. Bldg., Minneapolis, awarded contract for san. sewerage system and disposal plant, 14,200-ft. 8-12-in. vit. tile sewer, 40 manholes, 1 Imhoff tank, sludge bed and outlet, at $18,000.

Mont., Winnett—Two Miracle Concrete Co., Great Falls, awarded contract for ¾ miles of sewers, at $37,000.

Neb., Clay Center—Asplund Constr. Co., Tecumseh, Ia., awarded contract for sewerage sys., at $38,505; dis. plant to W. B. Castle, Sioux City, at $20,888.

Neb., Lincoln—National Cast Iron Pipe Co., Birmingham, Ala., award contract for cast iron for sewers and disposal plant, at $18,370.

N. J., Hillside—J. Miele, 21 Hillcrest Terrace, E. Orange, awarded contract by Twp. Clk. for 12,000-ft. 12-4-in. tile and conc. sewers, 75 manholes and 65 catch basins, at $99,989.

O., Cleveland—Gallagher-Burke Constr. Co., 1339 Irene Ave., Lakewood, awarded contract for sewer in Fairmount Rd., at $28,151; Manson Co., 343 The Arcade, contr. for Cedar Ave. sewer, at $20,594; Cedar Ave. sewer, E. 30th to E. 40th Sts., to Amato Constr. Co., 343 The Arcade, at $37,536.

Tex., Abilene—Janes Contracting Co., Dallas, awarded contract for construction of new sewer mains and constr. of sewage disposal plant, at approx. $36,000.

Tex., Harlingen—Krueger & Haynes Constr. Co., San Antonio, Tex., awarded contract for constr. of san. sewer, at $61,053. Plans call for 3,000-ft. 18-in. sewer, 11,260-ft. 12-in. sewer, 22,480-ft. 8-in. sewer, manholes, etc.

Wash., Seattle—T. W. Tomei & Co., 1017 E. 66th St., awarded contract for sewers and grading in 16th Ave., N. W. et al, 4,016-ft. 10-15-in. clay pipe, 18,850 c. y. grading, at $30,298.

WATER SUPPLY AND PURIFICATION

Ala., Bessemer—Long, Sullivan & Haggerty, 2014 2nd Ave., awarded contract by Tenn. Coal, Iron & R. R. Co., for laying 10,000-ft. 10-in. and 6,500-ft. 16-in. cast iron water supply pipe to Bessemer Furnaces, at $12,987. Owner will furnish material. Total cost $61,000.

Cal., Ventura—Fowler & Myers, San Fernando, awarded contract for constr. of 6 miles conc. pipe lines in Zones 1 and 2. Mutual Water Cos.; at $69,-438.

Colo., Boulder—Phelps & Son, Knoxville, Ia., awarded contract for rein. conc. reservoir, 8,000,000 gal. capy., at $57,400.

Que., Lambert—Contract let to Canada Iron Found. Co., Ville Ste. Pierre, for 5,000-ft. 6-in. c. i. water pipe, 179,000 lbs., at $58.80 per ton, 4,500-ft. 8-in. cast iron pipe, 234,450-lbs., $58.80 per ton, both Cl. C pipe; to Independent Concrete Pipe Co., Woodstock, 2,050-ft. 30-in. rein. conc., $6.96 per ft., at $14,268.

Que., Les Gres Falls—Shawinigan Engineering Co., Shawinigan Falls, (C. R. Lindsay, Res. Engr.), awarded contract for water power development costing $1,600,000 for Shawinigan Water & Power Co., Lrd., Shawinigan Falls.

Ont., Toronto—F. F. Fry, Ltd., 43 Scott St., awarded general contract for constr. of pumping station and sewers, at $43,000.

Ill., Aurora—S. B. Geiger, Old Colony Bldg., Chicago, awarded contract for drilling artesian well 2,300-ft. deep, 12-in. at bottom, at $29,960.

Iowa, Charlton—Following contracts let for water works impvts.: A. Phelps & Son, Knoxville, awarded contract for settling basin and building, at $11,-380; filtration plant to Pittsburgh Filtration Co., at $6,575.

Iowa, Marshalltown—Allis-Chalmers Mfg. Co., Milwaukee, awarded contract for furnishing 6,000,-000 gal. pump at $37,700.

Kan., Phillipsburg—Carrothers & Piburn, Colony, awarded contract for water works system, at $34,-086; filters to C. T. McFarland, 307 Mutual Bldg., Kansas City, Mo., at $3,400.

Me., Auburn—Portland Constr. Co., 52 Exchange St., Portland, awarded contract for electric pumping plant, 1 sty. 28x62-ft. brk. and rein. conc., at $16,500.

Miss., Biloxi—Following contracts let for constr. of water works: Chambers & Bowers, Hammond, La., at $3,300, for construction of reservoir (conc.); Pittsburgh-Des Moines Steel Co., Dallas, Tex., at $5,540 for steel tower and tank; Southern Jobbers' Supply Co., New Orleans, La., at $3,386, for motor driven fire pumps; National Cast Iron Pipe Co., Birmingham, Ala., at $26,462, for pipes and special steel pipe; A. B. Hayden, $2,039, for fittings; Columbia Iron Works, Chattanooga, Tenn., at $2,972, for hydrants, valves and boxes; S. A. Carnes, R. F. D. No. 1, Biloxi, at $8,237, for 12-ft. water main, and at $7,576, for laying 16-ft. water main. Plans and supervision by Swanson-McGraw, Inc., New Orleans.

Mo., Paris—Ray & Son, Baxter Springs, awarded contract for improving water works system, at $13,-150; pump to Chalmers Co., Kansas City, at $2,240; electric light pole line constr., etc., to O. Harley, Paris, at $6,100.

N. Y., Brooklyn—F. L. Paino, 572 1st St., awarded contract for mains in Blake St., here, at $67,455.

N. Y., New York—C. DeBlasio, 339 7th Ave., Mt. Vernon, awarded contract for mains in Bogart Ave., etc., at $21,000.

N. C., Kings Mountain—Guion & Withers, Gastonia, awarded contract for constr. of 500,000-gal. reservoir, rein. conc. and water and sewer line extension, at $59,768.

N. C., Newton—Electrical Constr. Co., 26 W. Fifth St., Charlotte, awarded contract for constr. of filtration plant, 7 miles water and sewer lines, etc., at $75,000.

O., Cleveland—Forest City Steel & Iron Co., 1500 W. 110th St., awarded contract for steel frame for Fairmount Pumping Sta., 1 sty., Fairmount Rd., at $135,037.

O., Cleveland—Gantose Constr. Co., Columbia Bldg., awarded contr. for 2,690-ft. 12-in. cast iron mains in Ridge Rd, no. of Linndale Rd., at $15,338; D. Lowensohn, Davis & Farley Bldg., contr. for 2,700-ft. 36 and 48-in. cast iron mains in Park Lane, Carnegie and Frank Aves., Baldwin-Fairmount Proj. Contr. 17, at $234,690.

S. D., Timber Lake—W. B. Carter, 606 United Bank Bldg., Sioux City, Ia., awarded contract for extending water mains, including 780 lin. ft. 8-in., 3,160-ft. 6-in. and 4,600-ft. 4-in. cast iron pipe, etc., at $14,763.

Tenn., Memphis—Memphis Artesian Water Works let following contracts for erection and equipment of pumpg. sta. on North Parkway: Contr. No. 7, main bldg., and part of equipment and all outside work to Gauger-Lorsmo Co., St. Paul, Minn., at $474,815; Contr. No. 8 for coal and ash-handling systems to Link-Belt Co., 300 W. 39th St., Chicago, Ill., at $26,800; Contr. No. 9 for secondary pumping units to Worthington Pump & Machinery Corp., 115 Broadway, New York, at $8,700; Contr. No. 10 for engines, generators and switchboard to Chuse Engine and Mfg. Co., Memphis, at $22,272. D. D. Thomas & Son, Memphis, contr. for reservoir, excav., etc.

Tex., Austin—T. A. M. Lockett Co., Houston, Tex., awarded contr. for installation of 725-h. p. boiler and 3-steam superheaters in boiler rm. at power house, at $21,100.

Tex., Pampa—R. Frick, Plainview, awarded contract for 14,700-ft. 6-8-in. cast iron Cl. B pipe, 14,000-ft. 2-in. galvanized iron pipe, 25 fire hydrants, 22 gate valves, etc., in place, at $25,992.

Tex., Victoria—Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., awarded contract for erection of water tower with capy. of 300,000 gals., at $14,607.

Wash., Tacoma—American Cast Iron Pipe Co., care R. C. Polk, Perkins Bldg., awarded contract for furnishing cast iron mains for So. J and K Sts., at $46,120.

Prospective Work

ROADS AND STREETS

Iowa, Sloan—Ready for bids about spring for approx. 30,000 sq. yds. paving here. W. E. Buell & Co., Davidson Bldg., Sioux City, Cons. Engrs., preparing plans. S. J. Oliver, Vil. Clk.

Fla., Ft. Pierce—State Rd. Dept., Tallahassee, plans hard surfacing and widening to 16-ft. 17 1-3 miles road in St. Lucie Co., from Ten Mile to Okeechobee Co. line; $110,000 available.

Iowa, Dyersville—Ready for bids about February 1st for approx. 52 blocks of paving. Alt. bids on vibrolithic, brk., blk., asph., conc., rein. conc., etc. N. B. Barber, Engr., Waterloo. W. C. Losebrock, City Clk.

Iowa, Williamsburg—Ready for bids about February 1st for approx. 52 blks. Engrs. Currie Engrg. Co., Webster City, making plans. Bert Hansen, City Clk.

Mich., Escanaba—City will repave First St., S and 11th Sts., removing macad. base and resurfacing with bitum. macad. with 3-in. tar-bound macadam. Will also pave portion of S. 9th St.

Minn., Lakeside—Wil call for bids in spring for about 25,000 sq. yds. paving. Petition circulated for additional paving. W. E. Buell & Co., Davidson Bldg., Sioux City, Ia., Cons. Engrs.

Minn., Minneapolis—City Council considering paving following streets in 1923: 4th St. N. E., 3rd to 13th Aves.; 43rd St., Linden Hills Blvd. to Upton Ave. S.; Upton Ave. S. bet. 43rd and 44th Sts. B. W. Elsberg, City Engr. About $100,000.

Miss., Meridian—Lauderdale Co. Commrs., Beat One, plan completing 4 miles Meridian-Vimville and Butler, Ala., Rd. $300,000 Fed. Aid asked.

Mont., Missoula—State Hwy. Comn. will have supervision over 7 rd. projects in this District in 1923. Roads will be built with Fed. Aid and will include: 12 mi. Arlee to Ravalli, gravel, $135,000; 6 mi. Ravalli to St. Ignatius, gravel, $45,000; 7 mi., Sanders Co. from Dixon West, gravel, $50,000; 12 mi., McDonald to Knowles, Sanders Co., gravel, $33,500; 31½ miles, Pablo to Rollins, Flathead Co., gravel, $287,500; Lookout Pass Rd., 3 miles, graded at cost of $20,000, has also been proposed. Half mile rd. at Tunah, $50,000, and 9 miles bet. Bearmouth and Drummond, $85,000, are also being considered for coming year's program.

Nev., Carson City—Plans have been completed on following projects included in 1923 program: 10.25 mi. 10-ft. gravel rd. Proj. 55, Churchill Co.; 4 miles grading and 25% surfacing Douglas Co.; 0.95 mi. 12-ft. gravel, Churchill Co.; 9.56 mi. 10-ft. gravel, Lincoln Co., Proj. 69; 8.20 mi. 18-ft. gravel surf., Clark Co., Proj. 37; 4.98 mi. grading and structures, Proj. 64, Churchill Co. Plans being prepared for the following: Proj. 70, City of Ely, 2.10 mi. 18-ft. asph. surf., White Pine Co.; No. 66 steel brdg., Washoe Co., 200-ft. span over Truckee at Wadsworth; 58, Overpass, Humboldt Co., over S. P. Ry. at Winnemucca; 72, 13.00 mi. grading in Humboldt Co., No. 72 and 13 mi. grading Humboldt Co. No. 71, No. 54, Deeth to Wells, Elko Co. Geo. W. Borden, State Hwy. Engr.

N. D., Wahpeton—City Council authorized constr. of 37 blocks of additional paving. S. H. Murray, City Clk.

S. D., Elkpoint—Will call for bids in spring for approx. 25,000 to 40,000 sq. yds. paving. Cons. Engrs. W. E. Buell & Co., Davidson Bldg., Sioux City, Ia. M. R. Hendrix, City Clk.

S. D., Minot—Ward County will construct 9 miles Fed. state hwy. no. from Minot. Start grading in spring. R. W. Kennard, Aud. Est. cost $610,459.

S. D., Sioux Falls—City Commrs. passed resolution for paving, grading and curbing various streets. Approx. 7,000 lin. ft. conc. curb, 57,500 sq. yds. paving. Walter Leyse, City Clk.

Tex., Center—Chf. Engr., Bureau Pub. Rds., Washington, D. C., has approved plans for 6 miles 16-ft. gravel rd., State Hwy. 35, Timpson to Attoyac River, at Nacogdoches Co. line. Est. cost $84,200. D. R. Taylor, Co. Judge, Center. I. R. Titus, Co. Eng., Timpson.

Wis., Appleton—Ontagamie Co. Bd. has appropriated $225,049 for co. and state aid road and brdg. constr., consisting of gravel and concrete. A. G. Brusewitz, Commr.; also $17,565 for purch. of road machinery, including tractor and 3 graders. A. G. Brusewitz, Commr.

Wis., Chilton—Calumet County Bd. has appropriated $55,957 for Co. and State Aid Rd. and brdg. constr.; also $8,000 for purchase of road machinery, including 1 heavy tractor and two 2-ton motor trucks. J. A. Gillis, Commr.

Wis., Crandon—Forest Co. Bd. has appropriated $107,452 for county and state aid road and bridge constr. in 1923. F. J. Rogers, Commr. Also $8,000 for road machy., including gravel crushing equipment. F. J. Rogers, Commr.

Wis., Eau Claire—Eua Claire Co. Bd. has appropriated $158,156 for Co. and St. aid road and bridge constr. in 1923. Gay Osborne, Commr. $30,000 appropriated by County for purch. of road machinery.

Va., Ft. Myer Heights—Arlington County Good Roads Assn. interested in new roads in County, and will petition Judge Brent to set date for special elec. to vote on $573,000 bonds.

Wis., Green Bay—Brown County Bd. has appropriated $1,085,044 for co. and state aid rd. and bridge constr. work, consisting of gravel and concrete. Geo. J. Cormier, Commr.

Wis., Kenosha—Kenosha County has appropriated $5,000 for purch. of road machinery, including steam shovel and 2 trucks. John F. Herzog, Kenosha, Commr., County Bd. has also made available for state and co. aid road and bridge constr., during 1923, sum of $131,954.

Wis., Marshfield—Contemplate paving estimated to cost $50,000. Will start work in spring. Geo. J. Leonhard, City Clk.

Wis., Mayville—May call for bids in February or March for abt. 25,000 sq. yds. paving. Jerry Donohue Engrg. Co., Sheboygan, completing plans. Albert Lentz, Clk.

Wis., Milwaukee—Division No. 2, C. R. Weymouth, Div. Engr., plans 158.7 miles work next year. Of this mileage 22.15 miles are hold-over jobs under contracts.

Wis., Sheboygan—Sheboygan Co. Bd. has appropriated $320,935 for county and state aid road and bridge constr. in 1923; also $30,000 for oiling gravel roads. Have also appropriated $55,000 for purchase of machinery, including gravel pit outfit. G. W. Ubbelohde, Commr.

Wis., Stevens Point—Portage County has appropriated $89,419 for co. and state aid road and bridge constr. in 1923. T. E. Cauley, Commr. County has also voted to purchase a number of patrol graders and road planers. T. E. Cauley, Commr.

SEWERAGE AND SEWAGE TREATMENT

Cal., Claremont—Olmsted & Gillelen, Hollingsworth Bldg., Los Angeles, submitted est. of cost of proposed sewer outfall to Council. Est. totals $139,000 and includes $99,000 for lat sys., $27,000 for outfall and $12,000 for disp. plant to be located in San Antonio wash. Specfs. call for main outfall sewer of 18-in. pipe, 2 main lines 10 and 12-ins. and laterals 2-in. diam. W. S. Smith, City Engr. Claremont has matter under advisement.

Cal., Fresno—City Engr. Wm. Stranahan preparing plans for construction of drain sewer sys. in about 20 city blocks along Stanislaus St., alley bet. L & M Sts., to H St. Will connect with present outfall sewer. Pipe will be 24-in. and will replace the 8-in. pipes now in place.

Cal., Glendale—J. B. Lippincott, 1104 Central Bldg., Cons. Engr., commissioned to prepare re-

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

port on sewage treatment plant and disposal problems of city. If report shows that treat. plant is required an Eastern sanitary expert will be asked to approve his plans and furnish estimates. City will pay fee of $3,000.

Cal., Los Angeles—Bd. Pub. Wks. has requested Council to grant permission to sell $2,000,000 of the twelve million dollar sewer bond issue voted in Aug. Of this sum $795,000 will be required for temp. outfall and 1st 3 units of emergency treatment plant, or exten. of pipe line to sea in case Venice will join Los Angeles in this disposal. $181,000 for Sec. 2 of no. outfall which is for grading Hyperion treat. plant site; $192,000 for screens, conc. and connecting sewers for so. plant of Sec. 3 and 417.

Cal., Los Angeles—City Atty. has been instructed by Council to prepare Ord. for sewage pumping plant to be installed in and to serve the Angeles Mesa Dist. Ord. adopted by Council to constr. 18-in. clay pipe storm sewer in Occidental Blvd., Bellevue Ave. to 1st alley no. and in portions of Andrews Blvd., including manholes, catch basins, covers, etc.; also cement pipe sewer, 12-21-in. diam. in Clinton St. bet. Commonwealth Ave. and Hoover St.

Cal., Morgan Hill—Plans being prepared for sewage disposal plant, $50,000. C. C. Kennedy, Call Bldg., San Francisco, Engr.

Ont., Fort Erie—City considering constr. of sewage disposal plant at cost of $45,000; also laying abt. 10 miles pipe, including elec. force pump, at cost of $215,000.

Ont., London—Plans being prepared by H. A. Brazier, City Engr., for storm sewer to cost $85,000 on Tecumseh Ave. and Wharncliffe Rd.

Ont., Toronto—York Twp. plans complete sewerage system, including vit. tile pipe with some sort of sewage disp. works. Two alternative schemes are proposed, one at cost of $846,170 and the other $1,050,425. F. Barber & Associates, 40 Jarvis St., Cons. Engrs.

Colo., Denver—Plans being made for South Side Special San. Sewer No. 7, including 27,000-ft. 8-in. vit. pipe. Est. cost $34,811. A. K. Vickery, City Hall, Engr.

Ill., Amboy—Board Local Impvts. will soon receive bids for treatment plant and outlet for sewerage system. F. W. Leake, City Engr.

Ill., Franklin Grove—Plans being prepared for new sewerage system to cost $100,000. Marr, Green & Co., 400 N. Mich. Ave., Chicago Cons. Engrs.

Ill., Sheridan—It is proposed to construct new sewerage system here at cost of $40,000.

Ill., Merrian—Plans being prepared for sewage disp. sys., $100,000. Marr, Green & Co., 400 N. Mich. Ave., Chicago, Cons. Engrs.

Iowa, Mechanicsville—Ready for bids about Feb. 10th for san. sewer sys. complete. C. H. Currie Engrg. Co., Webster City, Ia., Cons. Engrs. W. E. Davis, City Clk.

Iowa, Ossian—Completing plans for sewerage system. Cons. Engrs. Howard R. Green Co., 634 Cedar Rapids Savgs. Bk. Bldg., Cedar Rapids. Chas. Green, City Clk. Bids will be advertised for about the latter part of Jan.

Iowa, Washington—Will make survey in nr. future for new sanitary sewer system and disposal plant. W. E. Buell & Co., 205 Davidson Bldg., Sioux City. Est. cost $250,000.

Kan., Oakley—Plans being prepared for new sewerage system and disposal plant. Est. cost $50,000. C. A. Haskins, 517 Mutual Bank Bldg., Kans. City, Mo., Engrs.

Md., Hyattsville—Wash. Suburban San. Dist.—Robt. B. Morse, Chf. Engr.—plans expendt. of $2,000,000 during 1923 for water main and sewer extensions.

Mass., Springfield—Plans being prepared for reconstruction of sewers in Washburn, Lowell and Newland Sts., $40,000. Metcalfe & Eddy, 14 Beacon St., Boston, Engrs.

Mich., Holland—State Health Dept. has ordered City of Holland to take up its sewerage problem and construct sewage disp. plant; work to begin in 90 days.

Minn., Hibbing—Plans being made for extension of sewer mains in to Sargeant Addn.; also in Home Acres and Boulevard Grove Addns. C. E. Eveleth, City Clk.

Mo., Harrisonville—City will construct sewer system; will vote Jan. 9th on $60,000 bonds issue.

Mont., Missoula—It is proposed that city enter into contract for constr. of combination storm sewer draining sys. to effectually and permanently serve prop. of citizens on south side. City Engr's. est. for the impvt. placed at $609,638.

N. J., Newark—Plans prepared for additional storm water drains to relieve flooded conditions during heavy storms in sewer districts in S. 3d sec. of city, principally along Penn. R. R. tracks and Frelinghuysen Ave. Est cost, $292,000. Alexander Potter, 50 Church St., New York City, Civil Engr.

N. J., Trenton—Sewage disposal plant planned here. Est. cost, $1,250,000. G. A. Johnson Co., 150 Nassau St., New York City, Engrs.

N. Mex., Las Vegas—$50,000 bonds voted for new sewerage system here.

N. Y., Rochester—City plans constr. of sewers in several streets at estimated cost of $53,000 and constr. of sewage disposal plant in Hopper Hollow Dist. C. Arthur Poole, City Engr.

Ohio, Akron—$3,000,000 bonds voted here for trunk, san. and storm sewers in various sections of city. J. E. Root, Delaware Bldg., Engr.

Okla., Pauls Valley—$50,000 bonds voted here for storm sewers. Engrs., V. V. Long & Co., Colcord Bldg., Oklahoma City.

Pa., Pottstown—$200,000 bonds voted for sewage disposal plant.

Texas, Park Place—City voted $75,000 for sewers and $100,000 for paving; $50,000 for city hall and fire station.

Wash., Pullman—City will expend about $63,000 for adequate and san. sewage disp. system. G. H. & H. S. Green, Cons. Engrs., Spokane.

W. Va., Weston—City will construct sewerage disposal plant and pave streets. Votes Dec. 30th on $300,000 bonds.

Wis., Madison—City considering running pipe line 3½ miles through S. Madison, down Lakeside St., and concrete road to marsh. E. E. Parker, City Engr.

WATER SUPPLY AND PURIFICATION

Ariz., Flagstaff—Plans, estimates and report for water works rehabilitation and impvts. completed by Burns & McDonnell Engrg. Co., Kansas City, Mo.

Ark., Ft. Smith—City will expend $500,000 for extensions to water works system with capacity of 11,000,000 gals. Fagan Bourland, Chrmn.

Cal., Eagle Rock—Plans election to vote on $60,000 bonds and for sinking wells, laying additional mains and reservoir; $40,000 bonds for installing fire hydrants and additional mains.

Cal., Pasadena—Board of Directors plan $500,000 bond issue, $300,000 of which will be used to purchase plants and equipt. of Precipice Canyon and Pasadena Consolidated Water Companies, balance to extend present water mains and make further developments.

Cal., San Bernardino—Council considering Jan. 23rd as election date for resubmission of Devil Canyon $140,000 bond issue. S. W. McNabb, Mayor, states it is necessary to pass bonds at once in order that present legislature may act on them.

Cal., San Diego—City Mgr. F. A. Rhodes announces that a $400,000 bond issue will be required for new street impvt. program. New pipe for water mains will involve over $250,000.

Cal., San Diego—Escondido Mutual Water Co. and San Diego Co. Water Co. have executed contract for water develop. and constr. work in lands surrounding Escondido. Plans contemplated by agreement provide for immense conduit, including tunnels, utilizing present conduit of Escondido Mutual Water Co. on San Luis Rey river to Bear Valley reservoir, about 6 miles east and north of Escondido, to have capacity of 45,000,000 gals. water per day. Bear Valley reservoir is to be strengthened and capacity enlarged. Soon as conduit is completed San Diego Water Co. will erect elec. power plant at or near intake where there is a drop of several hundred feet.

Cal., San Francisco—Plans completed by City Engr. M. M. O'Shaughnessy for constr. of pipe section of Hetch Hetchy aqueduct between Irvington and Crystal Springs. Bids for constr. of project

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machinery Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

will be issued withihn 60 days. Specfs. provide for pipe line 19 miles in length, 60 ins. in diam., either riveted steel or welded; 2,050 ft. submerged pipe at Dumbarton Crossing; pumping plant to pump water to Crystal Springs reservoir. Total cost of proj., $5,000,000. N. A. Eckart, Chf. Asst. Engr.

Cal., San Pedro—Harbor impvts., planned by oil companies, include wharft, with loading sta., a storage and pump sta., costing $200,000. Union Oil Co., a 600-ft. wharf near drawbridge in west basin, $85,300, etc., etc.

Ont., North York Twp.—Twp. Council plans constr. of water works system to cost $125,000. H. D. Goode, Clk., Lansing.

D. C., Washington—Prince George's and Montgomery Cos., Maryland, Wash. Suburban San. Comn., Evans Bldg., Washington, D. C., have applied to Public Service Comn. for authority to issue from $500,000 to $1,000,000 for extension of water supply system in Prince George's and Montgomery Cos., near Washington.

Idaho, Lewiston—Surveys and plans under way for new water supply including 6 million gal. filtr. plant. Est. cost, $400,000. Wm. Thompson, Mayor. Burns & McDonnell Cons. Engrs., Kansas City, Mo.

Ill., Springfield—Water Supt. Walter Raid has instructed Burns & McDonnell, Cons. Engrs., Kansas City, Mo., to prepare plans and specfs. for water works filtr. and softening plant.

Ind., Bloomington—City Council voted to accept recommendation to locate new municipal water works plant on Griffy Crk., 4 miles north of city. Plant will cost about $866,000.

Iowa, Dubuque—Will soon call for bids for improving water plant new pumping station, etc. Daniel W. Mead, Madison, Wis., Cons. Engr. C. E. Carr, City Mgr. Est. cost, $300,000.

Iowa, Maurice—Ready for bids in April for water works system, san. sewers, etc. Cons. Engrs., W. E. Buell & Co., Davidson Bldg., Sioux City, making plans.

Fla., Deland—$100,000 water works bond voted; $140,000 paving bonds; $65,000 sewerage extension bonds. C. L. Allen, C. E. Condar, Bonds Trustees.

Fla., St. Petersburg—City voted $1,037,000 bonds for various impvts., including $160,000 for exten. of water mains and $50,000 for exten. of gas mains.

Fla., Tampa—City will vote Feb. 20th on $1,377,722 bonds for purchase of Tampa Water Works and on $1,272,278 bonds for extensions to plant. Nicholas S. Hill, Jr., New York City, Cons. Engr.

Ga., East Point—$75,000 bonds voted by city for water works and sewerage system.

La., Dequincy—J. W. Billingsly & Co. will be engineers on proposed $120,000 water works, light and power plant improvement. J. M. Gill, Twn. Clk.

La., Gretna—M. D. Kostmayer, F. C. Codifer, Jas. F. Turnbull and others interested in organizing company with $200,000 capital to take over water power franchise in portion of Jefferson Parish on east bank of river above city extending from protection levee to line of St. Charles Parish and from river to Lake Pontchartrain.

Minn., Fridley—J. A. Jensen, Supvr. of Water Works, has recommended that pumping sta. and filtr. plant be built as soon as possible. 40,000,000 gal. sta. N. W. Elsberg, City Engr. Est. cost, $2,673,360.

Minn., Winona—Prelim. plans made for artesian water works sys. Alvord, Burdick & Howason, 8 S. Dearborn St., Chicago, Hydraulic Engrs. System will include reservoir in Levee Pk. with 2,000,000 gal. storage capacity. Geo. W. Hoffman, City Clk.

N. Y., Liberty—Taxpayers have authorized Trustees of village to borrow on bonds to sum of $130,000 for constr. and laying of mains and exten. of village water mains. It is expected a gravity flow sys. will be installed.

N. Y., Rochester—Lake Shore Water District having prelim. plans prepared for 10 miles 6½-in. mains. Est. cost, $180,000. R. E. Gaskin, Engr.

N. C., Albemarle—Town will extend water works system and construct 2 bldgs., brick and concrete, 25x30 ft.; 1,000,000 gal. daily capacity; will construct rein. conc. coagulating basin, 35x80x12 ft. Est. cost, $40,000. Date of opening bids not decided. Gilbert C. White, Engr., Durham, N. C.

Hickory, N. C.—City will expend about $300,000 for establishment of water plant. Plans not complete. J. W. Bollen, City Engr.

N. C., Mooresville—Town will construct new plant; brk. and conc., 44x37 ft., 2-sty., 720,000 gal. daily capacity; will install water-driven centrif. pumps; will construct 500,000 gal. conc. reservoir; rein. coagulating basin 30x50x22 ft.; also plans to construct 5 miles 12-in. cast iron pipe line. G. C. White, Cons. Engr., Durham, N. C.

Okla., Woodward—$175,000 bonds voted for constr. of water works plant and distribution system. Black & Veatch, Engrs., Mutual Bldg., Kansas City, Mo.

Ore., Ashland—City Council considering constr. of new water system. Est. cost, about $200,000.

Ore., Portland—Supt. of water works receives bids next year for No. and So. Portland pumping sys., $20,000; Sandy River Control sys., $3,000; Vernon standpipe and house, $35,000; Myrtle Park sys., $8,000; Fulton and Burlington sys., $3,000; repairs to present sys., $209,350.

S. C., Greenville—City contemplates impvts. to water sys., to increase capacity by 200 per cent, involving expendt. of about $2,500,000. Howard W. Perry, Supt. of Water Works.

S. D., Rapid City—Bids will be received early in January for water works impvts. costing $175,000. Burns & McDonnell, Cons. Engrs., Interstate Bldg., Kansas City, Mo.

Texas, Dallas—City Comn. will take bids about middle of January for two 2,000,000 gal. water towers, conc. or steel, one at Belmont and the other at Junius Heights. $40,000. G. D. Fairtrace, City Engr.

Texas, Elgin—$40,000 bonds voted here for filtration plant and cast iron pipe line.

Texas, Hamilton—A $90,000 bond issue voted at recent election for providing more adequate water system for city.

Texas, Perryton—$100,000 water and light bonds voted here.

Texas, Rotan—$50,000 voted for water works improvements here.

Texas, Vernon—City will develop auxiliary water supply on tract of 21 acres; will construct reservoir of from three to five million gals. capacity; pumpg. sta. and 10-in. water main will also be installed. A. J. Robinson, City Engr.

Wash., Everett—State Board of Public Works has ordered Birmingham Water Co. to double size of trunk line to extend the intake 1,000 ft. into deep water of lake, to install chlorination plant and not to collect any further rent until these impvts. are completed.

Wash., Yakima—Plans under way to acquire distributing sys. of Pacific Power & Light Co., $400,000; 30 mi. pipe line from Rattle Snake Crk., $750,000; reservoir, $150,000. Plans elec. to vote on $1,000,000 bonds. C. F. Wilson, City Engr.

Wis., Madison—City water found impure by tests. May adopt pressure sys. of pumping. E. E. Parker, City Engr.

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From Daily Sentinel, Rome, N. Y., Friday Evening, February 24, 1922.

ROME DISTANCES AUBURN

Auburn Boasts of a 17-Year Old Pavement—Rome Has One 19 Years Old

A report from Auburn, including an interview with the city manager, John P. Jaeckel, says:

"Speaking of the work done during the past season, City Engineer Dullea was especially pleased with the Warren Brothers' bitulithic pavement put in by Brayer Brothers in lower Clark Street and Swift Street. When these contractors finish a resurface of bitulithic in upper Clark Street this spring, for which contract has already been given as part of last year's program, this street will carry the heavy east and west traffic across the state.

"Mr. Dullea pointed to the North Street pavement from the Holy Family Church to the cemetery, a bitulithic, built 17 years ago, and which has given the city excellent service, as proof of the worth of this type of paving, which will probably be used in South Street, Grant and Hamilton Avenues in 1922 work; the pavement of bitulithic from the North Street cemetery to the city line, over which thousands of tons of stone have been hauled during the past six years, as further indication that bitulithic, besides being one of the best appearing pavements known, can stand the wear and tear of heavy usage. North Street has been put to the most severe test of any pavement in the city.

"However, while the wearing qualities under hard use will be the acid test for the pavements to be laid in Hamilton Avenue, and Grant Avenue, in South Street, Auburn's show street, appearance will be a big factor when the contract for this work is awarded. Again bitulithic seems likely to be designated by the council, as the Warren Brothers' product used so successfully here in the past stands up under this test."

Auburn has nothing on Rome in this regard. Rome has a bitulithic pavement on North James Street, laid over a compressed broken stone base in 1902. It has been in use 19 years and still is giving excellent service.

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—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
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—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
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Concrete Road Building Again Breaks All Records

79,000,000 square yards of Concrete pavement were placed under contract last year—a gain of more than 40 per cent over 1921, the largest previous year.

The construction thus provided for, and to a large extent completed, is equivalent to more than 7,480 miles of 18-foot pavement.

That is a larger amount of concrete highway than there was in the country altogether up to 1917.

These facts witness the determination of this country to have roads equal to the traffic they bear.

Yet even with this great record, the output of motor vehicles continues to outstrip by far the construction of motor roads.

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EXPANSION JOINT

PROVED AND ACCEPTED

Above— Railroad Street, Madison, Wis. Built 1915. Carey Elastite Expansion Joint every 30 feet. Photographed July, 1919.

At Left— Illinois State Highway between Dwight, Ill. and Gardner, Ill. Built by State of Illinois. W. H. Hartman, Supt. of Construction. Carey Elastite Expansion Joint is used as a concealed center line longitudinal joint, about half of which is the new tongue and groove type.

Two methods of installing Carey Elastite Expansion Joint in concrete streets and highways

IN a section of the Illinois State Highway between Dwight and Gardner the concrete is laid in one apparently continuous slab without transverse joints except at the end of each day's run—a distinctive idea in concrete road construction.

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The picture of Railroad St., Madison, Wis., shows the usual method of installing Carey Elastite Expansion Joint across the roadway at intervals of thirty feet.

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It is often convenient to install a concealed or submerged longitudinal joint, which allows the finishing machine to operate without interference from joint projecting above the surface.

In this construction, the road is built full width at one operation. Carey Elastite Expansion Joint being set vertically in the road, supported by stakes. The stakes may be driven below the surface and left in the road or allowed to project above the surface and pulled before finishing.

For this construction Carey Elastite Expansion Joint is superior as its stiffness keeps it in position with few stakes.

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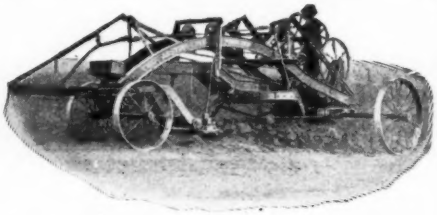

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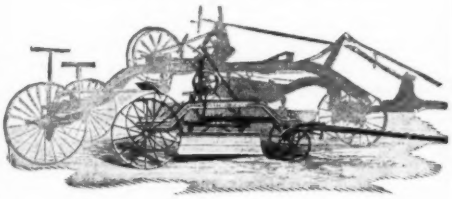

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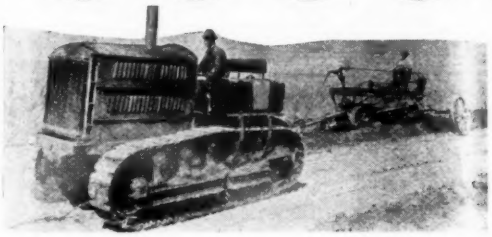

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Okmulgee County, Oklahoma, lies in the center of a vast field, where pipe casings and boilers, weighing many tons, are continually hauled over the roads. This heavy freighting, which does not stop even in muddy weather, is a severe test of roads. After experimenting with various other kinds of road building machinery, Okmulgee County Commissioners purchased a 10-ton "Caterpillar."* Its performance resulted in repeat orders until Okmulgee now operates a fleet of nine "Caterpillars."* The Commissioners write: "Since buying the 'Caterpillars'* we have graded and maintained hundreds of miles of roads in this county and the work has been done at approximately one-half the cost we have been able to do it with any other equipment." The "Caterpillar"* method of handling public works of every kind is of interest to every county, township and city officials. Our booklet, "The Nation's Road-Maker" will be sent on request.

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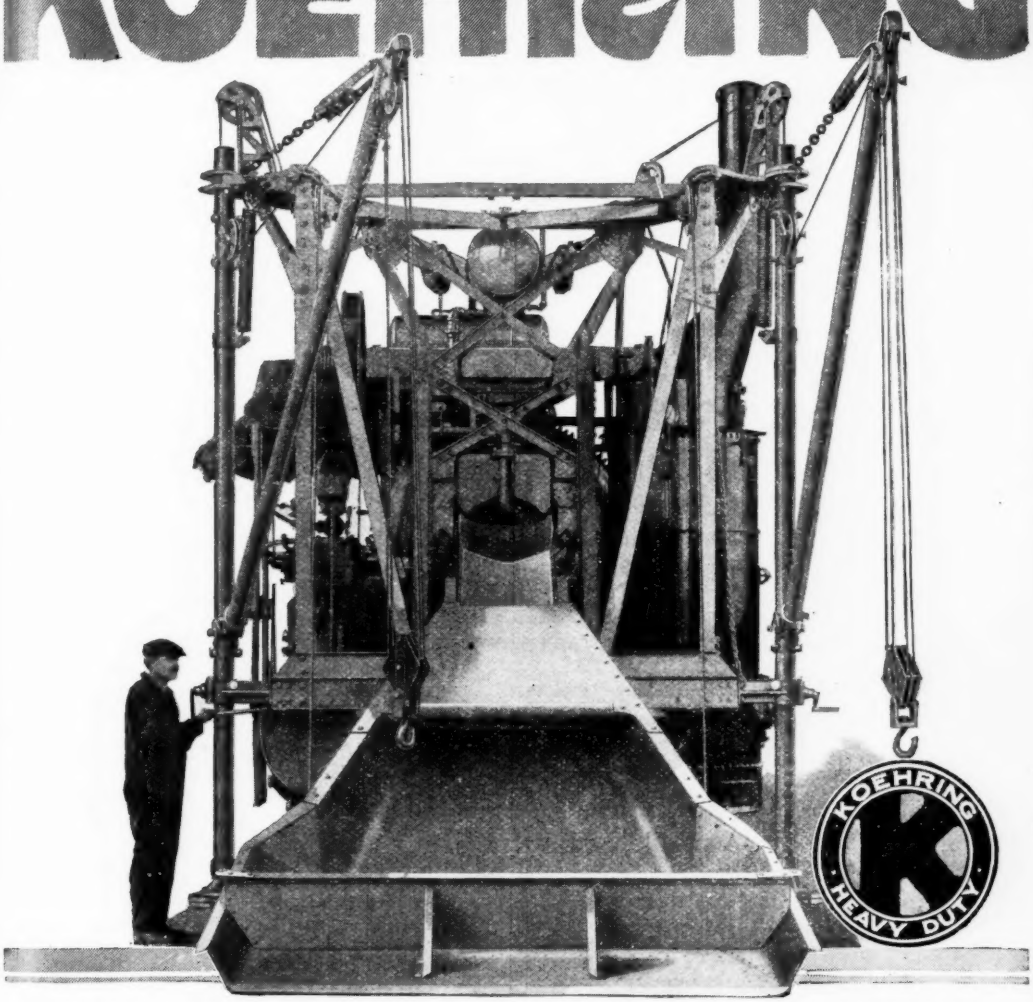

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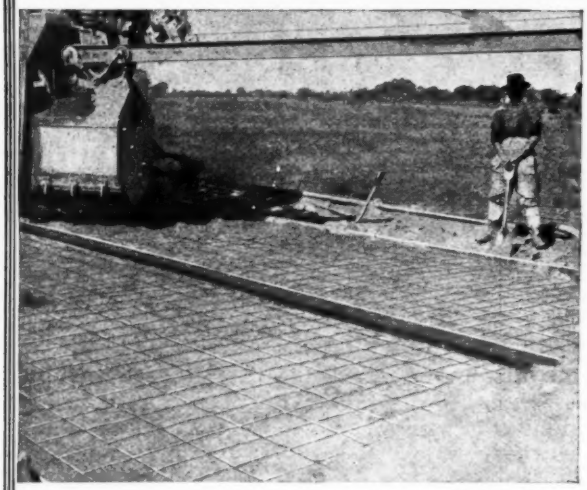

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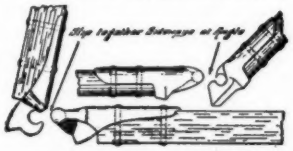

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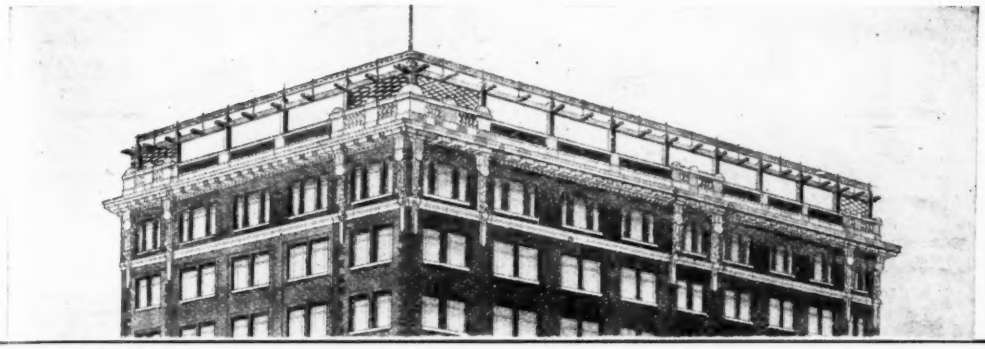

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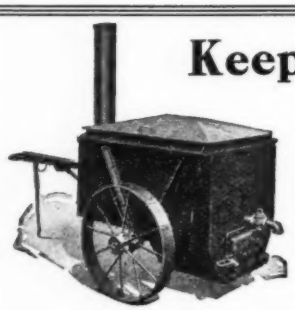

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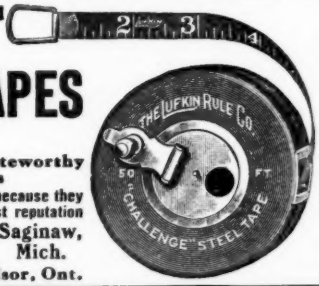

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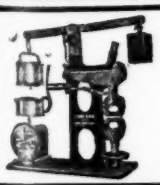
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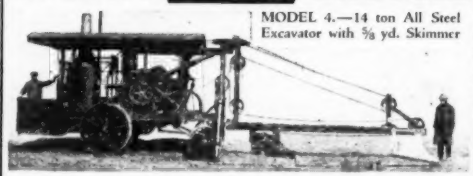

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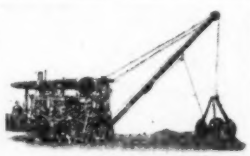

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